NUS CORPORATION
A Halliburton Company

D-31-9-4-8
DRAFT
NB-99-DII-FS-A

Superfund Records Center
SITE: New Bedford
BREAK 4.6
OTHER 220941

ADDENDUM

DRAFT FEASIBILITY STUDY OF REMEDIAL ACTION ALTERNATIVES

ACUSHNET RIVER ESTUARY
ABOVE THE COGGESHALL STREET BRIDGE
NEW BEDFORD SITE
BRISTOL COUNTY, MASSACHUSETTS

EPA WORK ASSIGNMENT
NUMBER 28-1L43
CONTRACT NUMBER 68-01-6699

NUS PROJECT NUMBER 0725.16

SEPTEMBER 1984

SDMS DocID 000220941

NUS CORPORATION

Park West Two
Cliff Mine Road
Pittsburgh, PA 15275
412-788-1080

D-31-9-4-8
DRAFT
NB-99-DII-FS-A

ADDENDUM

DRAFT FEASIBILITY STUDY OF REMEDIAL ACTION ALTERNATIVES

ACUSHNET RIVER ESTUARY
ABOVE THE COGGESHALL STREET BRIDGE
NEW BEDFORD SITE
BRISTOL COUNTY, MASSACHUSETTS

EPA WORK ASSIGNMENT
NUMBER 28-1L43
CONTRACT NUMBER 68-01-6699

NUS PROJECT NUMBER 0725.16

SEPTEMBER 1984

SUBMITTED FOR NUS BY:

JOSEPH G. YEASTED
PROJECT MANAGER

APPROVED:

DONALD SENOVICH
MANAGER, REMEDIAL PLANNING

A Halliburton Company

CONTENTS

SECTION		PAGE
1.0	**INTRODUCTION**	**1-1**
2.0	**DREDGING WITH DISPOSAL INTO IN-HARBOR SUBSURFACE CELLS**	**2-1**
2.1	DESCRIPTION	2-1
2.2	EVALUATION OF COST-EFFECTIVENESS	2-22
2.2.1	ENVIRONMENTAL EFFECTS	2-22
2.2.2	PUBLIC HEALTH EFFECTS	2-27
2.2.3	PUBLIC WELFARE AND COMMUNITY EFFECTS	2-29
2.2.4	MISCELLANEOUS COST-EFFECTIVENESS MEASURES	2-30
2.2.5	ESTIMATED COSTS	2-31
3.0	**INCINERATION OF PCB-CONTAMINATED SEDIMENTS**	**3-1**
3.1	REVIEW OF INITIAL SCREENING OF INCINERATION ALTERNATIVES	3-1
3.2	ROTARY KILN INCINERATION	3-3
3.3	REGULATORY FRAMEWORK	3-5
3.4	PUBLIC HEALTH AND ENVIRONMENTAL EFFECTS	3-7
3.5	ADDITIONAL EVALUATION FACTORS	3-8
3.6	CONCLUSIONS AND RECOMMENDATIONS	3-9
4.0	**DISPOSAL AT AN EXISTING, OUT-OF-STATE LANDFILL**	**4-1**
4.1	LANDFILL DISPOSAL OF PCB-CONTAMINATED WASTES	4-1
4.2	CECOS INTERNATIONAL LANDFILL	4-2
4.3	DESCRIPTION OF ALTERNATIVE	4-3
4.4	PUBLIC HEALTH AND ENVIRONMENTAL EFFECTS	4-4
4.5	ADDITIONAL EVALUATION FACTORS	4-5
4.6	CONCLUSIONS AND RECOMMENDATIONS	4-7

TABLES

NUMBER		PAGE
2-1	COST ESTIMATE - DREDGING WITH DISPOSAL IN SUBSURFACE CELLS	2-32

FIGURES

NUMBER		PAGE
2-1	PLAN VIEW OF HARBOR ILLUSTRATING SUBSURFACE DISPOSAL ALTERNATIVE	2-2
2-2	CROSS SECTION TEMPORARY CONTAINMENT SITE	2-4
2-3	TYPICAL CROSS SECTION DISPOSAL CELL SUBSURFACE DISPOSAL ALTERNATIVE	2-7
2-4	PLAN VIEW ILLUSTRATING PORTION OF HARBOR SUITABLE FOR CELL DEVELOPMENT SUBSURFACE DISPOSAL ALTERNATIVE	2-8
2-5	PLAN VIEW ILLUSTRATING DISPOSAL CELL LOCATIONS SUBSURFACE DISPOSAL ALTERNATIVE	2-9
2-6	SUBSTEPS 1 AND 2 - SUBSURFACE DISPOSAL ALTERNATIVE	2-11
2-7	SUBSTEP 3 - SUBSURFACE DISPOSAL ALTERNATIVE	2-12
2-8	SUBSTEP 4 - SUBSURFACE DISPOSAL ALTERNATIVE	2-13
2-9	SUBSTEP 5 - SUBSURFACE DISPOSAL ALTERNATIVE	2-14
2-10	TYPICAL CROSS SECTION DISPOSAL CELL AFTER COMPLETION SUBSURFACE DISPOSAL ALTERNATIVE	2-16
2-11	SUBSTEP 10 - SUBSURFACE DISPOSAL ALTERNATIVE	2-17
2-12	SUBSTEP 12 - SUBSURFACE DISPOSAL ALTERNATIVE	2-19
2-13	SUBSTEP 13 - SUBSURFACE DISPOSAL ALTERNATIVE	2-20

1.0 INTRODUCTION

On August 23, 1984, a draft report on the fast-track Feasibility Study for remediation of PCB hot-spot areas in the Acushnet River above the Coggeshall Street Bridge was released for public review and comment. The report, as issued, presented a detailed evaluation of the no-action alternatives and four remedial action alternatives. In this addendum to the draft Feasibility Study report, three other remedial actions are addressed. These include the dredging of PCB-contaminated sediments with disposal in in-harbor subsurface cells; the dredging and incineration of contaminated sediments; and the dredging of contaminated sediments with disposal in an existing, out-of-state landfill.

The alternative of dredging with disposal in subsurface cells was developed and evaluated in response to review comments by involved agencies that at least one alternative should provide for in-harbor disposal of the contaminated sediments without irreversibly damaging or destroying wetland areas along the shorelines of the estuary. This alternative, which represents a fifth remedial action alternative for the hot-spot areas, was developed as a modification of similar alternatives that were previously deemed technically infeasible. In this addendum to the draft report, details will be presented on the technical aspects of the subsurface cell alternative, its cost-effectiveness, and the expected effects on public health, the environment, and public welfare.

The incineration and out-of-state disposal alternatives have been previously evaluated both as comprehensive remedial actions for all of the contaminated sediments within the hot-spot areas, and as a subaction for only those sediments with PCB levels exceeding 500 ppm. It was concluded that neither of these alternatives represent cost-effective actions for the particular conditions under study. Numerous reasons for eliminating these alternatives are given in the draft report, including the particularly high costs and implementation time required. A detailed presentation of these alternatives was not provided, however, since incineration and out-of-state disposal were eliminated prior to the selection and detailed presentation of the recommended alternatives. For reasons discussed below, a more detailed justification for eliminating these alternatives will be provided in this addendum.

The principal reason for the additional justification is that draft policy guidelines issued by the EPA subsequent to the elimination of incineration and out-of-state disposal have modified the decision criteria so that a more comprehensive analysis became necessary. This guidance, issued in July 1984, encourages treatment of Superfund wastes and tightens conditions for land disposal. The intent is to minimize potential damage to public health and to the environment by avoiding the creation of new hazardous waste sites, even though higher costs may be incurred. The following is taken from the EPA memorandum announcing the draft guidance (as reported in the Environment Reporter, July 27, 1984):

> Treatment alternatives may be more effective in minimizing damage to public health or the environment than land disposal. Although such alternatives may be more expensive than offsite land disposal, these alternatives should not be rejected on the basis of cost alone. Section 300.68(h)(l) of the National Contingency Plan (NCP) allows rejection of alternatives during the screening stage based on cost, only when the alternative far exceeds the cost of others (e.g., by an order of magnitude) and does not provide substantially greater public health and environmental benefit. Alternatives to land disposal often can provide substantially greater public health and environmental benefits. Therefore, such alternatives generally should not be screened out based on cost alone. Treatment alternatives can be more protective of public health and the environment than can land disposal. Therefore, such alternatives may be recommended as the appropriate remedial action in cases where the detailed analysis of alternatives shows that the alternative is more effective than others in minimizing and mitigating the damage to public health, welfare, or the environment.

The draft report includes a thorough review of treatment technologies for PCBs in relation to the particular conditions of hot-spot areas in the Acushnet River Estuary. The conclusion was that incineration represents the only demonstrated and EPA-approved technology appropriate for use in remediating the hot-spot areas. In order to properly address EPA's draft guidance, therefore, it becomes imperative to comparatively assess and document the effectiveness of incineration in minimizing and mitigating the damages to public health, welfare, and the environment in relation to the other proposed alternatives.

Generally, the regulations governing the disposal of PCBs require that whenever disposal of PCBs is undertaken, the PCBs must be incinerated unless the concentrations are less than 50 ppm. The rules, however, provide for certain exceptions to the incineration requirement. The principal alternative is disposal in an EPA-approved landfill for PCBs. Under the new EPA draft guidance, offsite disposal of hazardous substances must take place at a facility regulated under the Resource Conservation and Recovery Act (RCRA).

The proposed alternative of dredging contaminated sediments with disposal in an upland landfill would, by design, represent an alternative to incineration that satisfies current regulations. No RCRA landfills currently exist in Massachusetts; however, and serious concerns remain as to the acceptability and permitting of a new RCRA facility in the Commonwealth. For this reason and because of the new draft guidance, greater emphasis is placed on disposal at an existing, out-of-state RCRA landfill as an alternative to incineration or to the in-harbor (i.e., onsite) disposal alternatives.

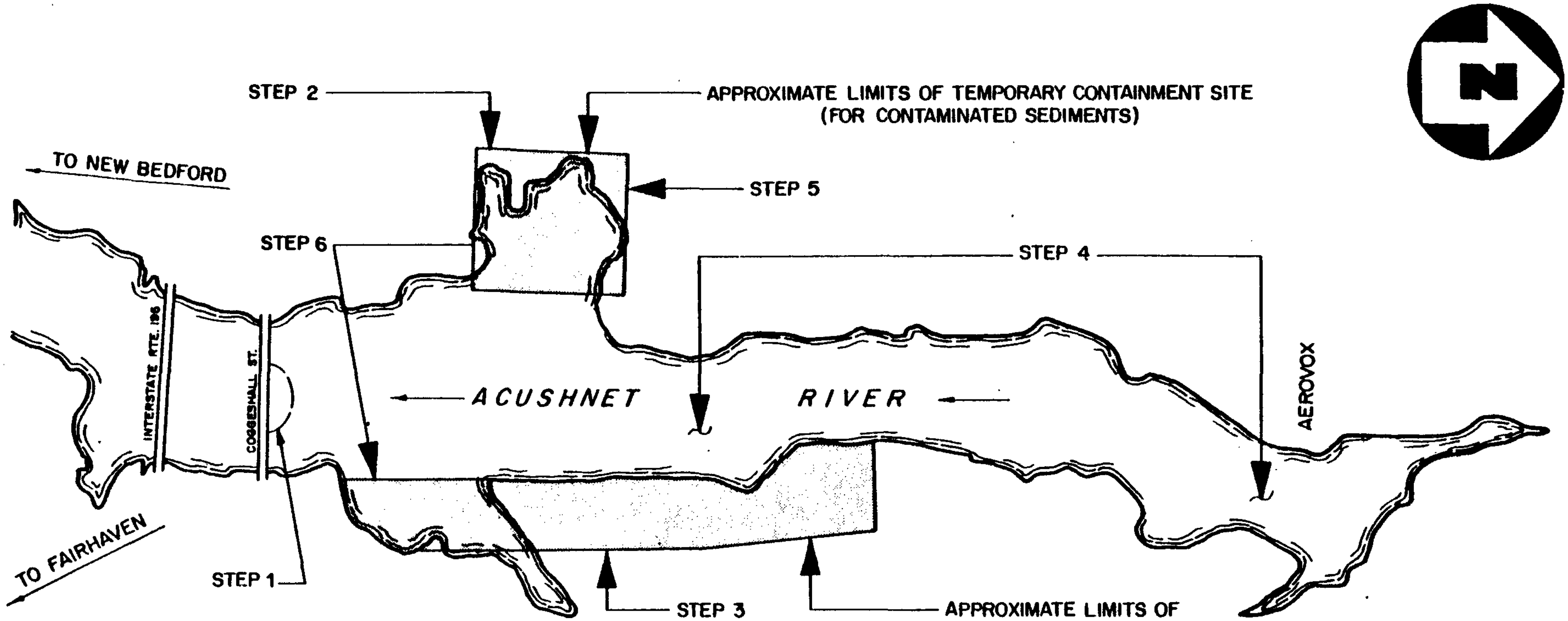
2.0 DREDGING WITH DISPOSAL IN IN-HARBOR SUBSURFACE CELLS

2.1 Description

This alternative required dredging of contaminated sediments from the harbor bottom north of the Coggeshall Street Bridge. An approximate 3-foot layer containing contaminated sediments will be dredged and contained in a series of cells, which will be excavated approximately 10 feet into the harbor bottom. Clean sediments obtained during development of the cells will be used to cover the contaminated sediments in the disposal cells and remaining portions of the harbor bottom. Upon completion of this alternative, the harbor bottom will have been returned essentially to its original elevation. Temporary containment sites will be constructed in the western and eastern coves for the storage of contaminated and clean sediments, respectively, during remediation. Sediment dispersal control structures will be installed at the harbor opening beneath the Coggeshall Street Bridge prior to dredging activities. A plan view indicating the sequential steps of this alternative is presented as Figure 2-1.

Step 1: Install Sediment Dispersal Control

Sheet piling will be driven to form a barrier across the opening under the Coggeshall Street Bridge. In order to develop lateral support, the piling will be driven through the soft harbor sediments and into the underlying sand and gravel layers. The piling will be placed to form a pair of parallel walls, which will be cross-connected and braced by additional sheet pile sections attached to the walls with "T" joints. Rockfill or glacial till will then be placed into the space between the walls to give the combined structure additional resistance to lateral forces created by tidal fluctuations. The top of this structure should be approximately at the mean low-tide elevation so that tidal waters can freely pass over the top of the piling. The depth to which the sheet piling should be driven will depend on the characteristics and depths of the subsurface materials, and further investigation of these parameters will be required for final design.



STEP 1. INSTALL SEDIMENT DISPERSAL CONTROL

STEP 2. CONSTRUCT TEMPORARY CONTAINMENT SITE (FOR CONTAMINATED SEDIMENTS)

STEP 3. CONSTRUCT TEMPORARY CONTAINMENT SITE (FOR CLEAN SEDIMENTS)

STEP 4. DEVELOP, FILL, AND CAP SUBSURFACE CONTAINMENT CELLS

STEP 5. TREAT WATER

STEP 6. REMOVE TEMPORARY CONTAINMENT EMBANKMENTS

0 1000 2000

SCALE IN FEET

FIGURE 2-1

PLAN VIEW OF HARBOR ILLUSTRATING
SUBSURFACE DISPOSAL ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

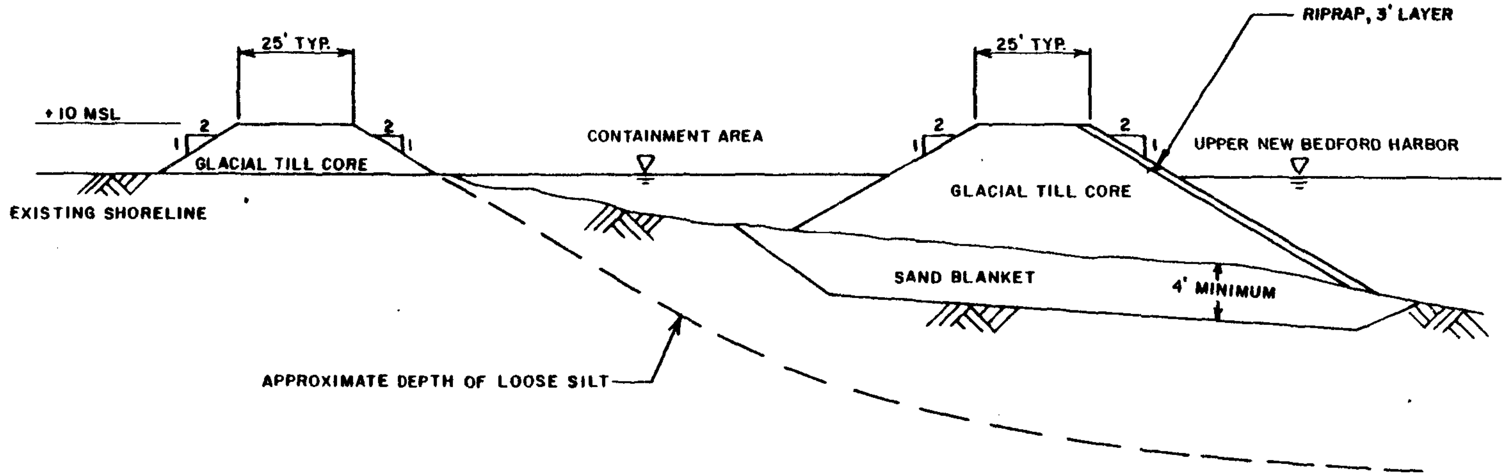
NUS CORPORATION

A Halliburton Company

A double silt curtain is to be employed in conjunction with the sheet piling. The curtain, which will be suspended from buoys on the water surface, will be located upstream of the sheet piling at a distance beyond where water velocity increases over the piling walls. Weights will be attached to the bottom of the skirt in order to maintain proper positioning of the curtain. The skirt should extend to within 1 to 2 feet of the harbor bottom, but should not extend more than 10 feet into the water. Maintenance requirements for the silt curtain will be developed during final design.

Step 2: Construct Temporary Containment Site (for contaminated sediments)

The western cove in the upper harbor will be developed into a temporary containment site for the contaminated sediments. A sand blanket will first be placed on existing sediments in the estuary and cove to provide adequate support for the glacial till embankment. The thickness of this blanket will be approximately 4 feet, but may be greater depending on physical properties of the harbor sediments. During final design, consideration will also be given to the use of geotextiles, geogrids, and other soil reinforcement systems as alternatives to the sand blanket. Glacial till will then be placed either on the sand blanket or on the existing shoreline to form a containment embankment with a final grade at approximately +10 feet msl. The fill will be placed and compacted in lifts in thickness between 6 and 12 inches, and the completed embankments will have 2H:1V side slopes. Material placed on the existing shoreline can be compacted using a vibratory roller. If, during detailed design it is found that vibratory compaction methods are not suitable for in-harbor use because of the potential for liquefication of the underlying fine-grained material, other compaction methods will be specified. Finally, the embankment will be covered with riprap on the side adjacent to the harbor. The approximate location of the containment is indicated on Figure 2-1. A typical cross-section of the temporary containment site is presented in Figure 2-2.



TYPICAL CROSS-SECTION
TEMPORARY CONTAINMENT SITE
NEW BEDFORD HARBOR SITE, NEW BEDFORD, MA
NOT TO SCALE

FIGURE 2-2

NUS CORPORATION
A Halliburton Company

Step 3: Construct Temporary Containment Site (for clean sediments)

A containment site will also be constructed in the eastern cove of the upper harbor for storage of sediments dredged from the subsurface cells. Initially, contaminated sediments will be removed from beneath the proposed eastern containment site location and placed in the western cove containment site. Embankment construction will then proceed in the manner discussed in Step 2. Figure 2-1 shows the approximate location of the eastern temporary containment site. It should be noted that nearby buildings and structures constrain the width of this containment site such that a square (optimal) configuration is not possible for the location indicated.

Step 4: Develop, Fill, and Cap Subsurface Disposal Cells

A hydraulic pipeline cutterhead dredge will be used for all proposed dredging operations. This dredge will be fitted with a bucketwheel cutterhead that has recirculating capacity for the dredged water. This type of dredge can be used at dredging rates of 70 to 250 cubic yards per hour (in-situ sediments). The production rate is variable, depending on the sediment particle size and the equipment size. Typical dredge cuts will be approximately 3 feet in depth. A hydraulic pipeline will convey the slurry to the temporary containment area or disposal area.

Based on regional geologic history and the limited available test boring information on subsurface conditions, it is anticipated that the upper 10 to 15 feet of the harbor sediments are composed of soft silts or soft sandy silts. It is also expected that the underlying glacial outwash deposits will be relatively free of cobbles and boulders. Regardless, a design depth limitation of 10 feet into the clean sediments was established in order to reduce the possibility of dredging of relatively coarse particles (e.g., boulders and cobbles) from the glacial deposits.

In developing a cellular approach to subsurface disposal, the effect of extensive removal of sediments on the stability of the harbor shoreline and adjoining facilities must be considered. Design *sideslopes* of 10H:1V *for the dredge cuts* were selected based on the anticipated angle of repose of soft silty sediments in a submerged condition. The disposal cells will be located to provide for at least 100 feet of clearance between the shoreline and the top of the dredge cut for the sides of the cells. Under anticipated "worst case" conditions with a failure slope of 20H:1V in the cell sideslopes, the 100-foot zone will ensure the continued stability of existing shoreline structures. Modifications of the buffer zone may be necessary to accommodate storm sewer and industrial outfalls along the shoreline. These details will be resolved during final design. A typical cross-section of the proposed *disposal* cell construction is presented as Figure 2-3.

It was also determined that the cells should be constructed with an embankment of in-situ clean sediments remaining between each cell, in order to maintain the structural integrity of existing cells while a new cell is being dredged. For preliminary layout purposes, an embankment top width of 100 feet was considered suitable. As such, the harbor bottom remaining to serve as these embankments will *not be available for cell development. The coves on the eastern and western* shorelines will be used for temporary containment and thus are also unavailable for cell development. Similarly, the deep portion of the upper harbor near the Coggeshall Street Bridge will not be suitable for cell development because of the potential for long-term scour of the sediment cap. Therefore, the portions of the harbor available for the construction of disposal cells are limited to the areas presented in Figure 2-4.

Considering the aforementioned constraints, a layout of five cells was selected, with each cell having a capacity of approximately 200,000 cubic yards (yd^3). The cells will be dredged to a depth of 10 feet below the depth of contaminated sediment removal. A plan view of the proposed cell locations is presented as Figure 2-5. Although other cell sizes and configurations were considered, the "5-cell" layout appears to best accommodate the previously discussed spacial limitations of dredging of the upper harbor.

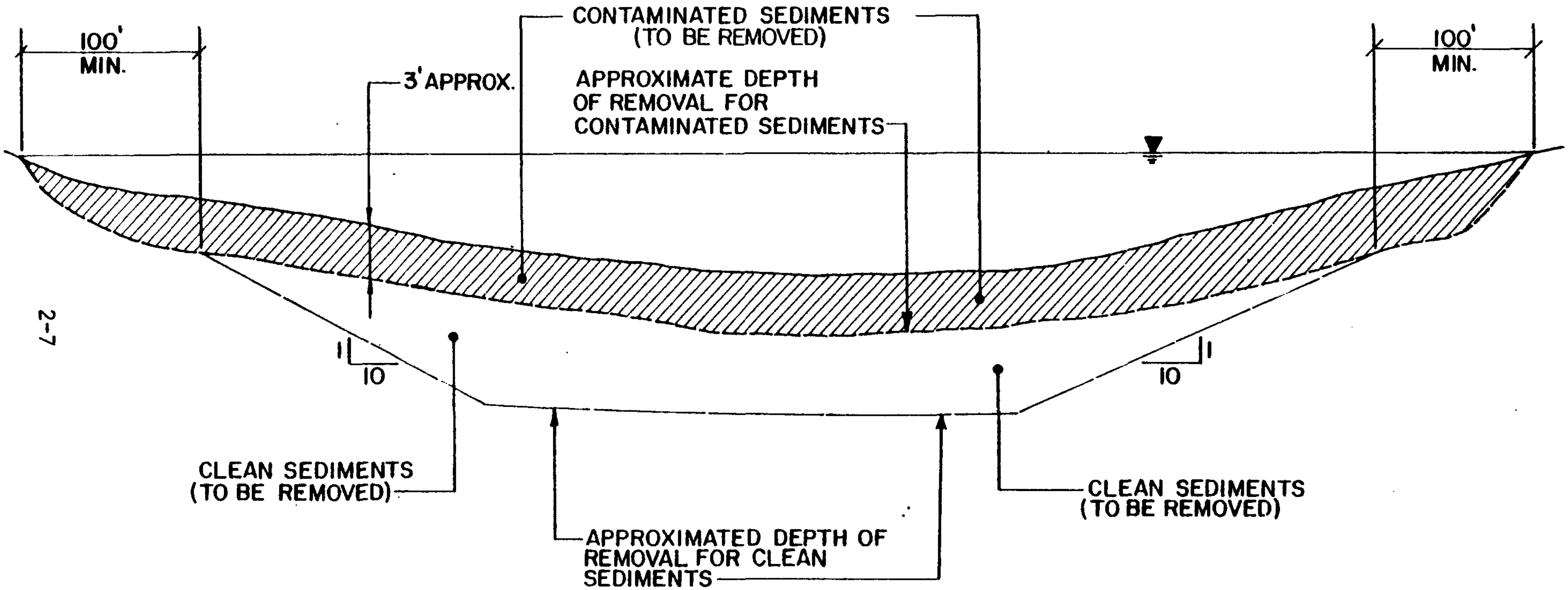
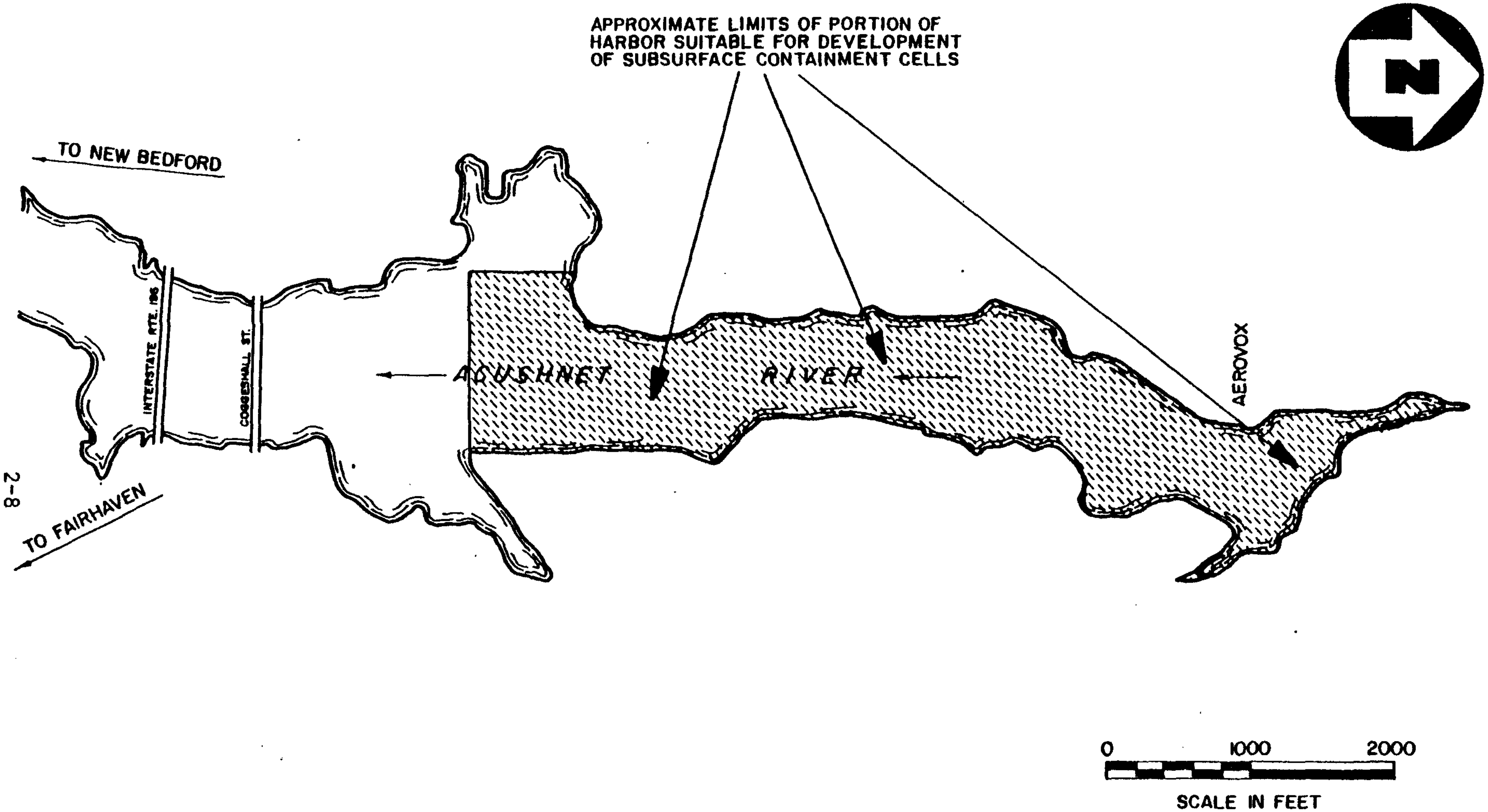


FIGURE 2-3

TYPICAL CROSS SECTION - DISPOSAL CELL
SUBSURFACE DISPOSAL ALTERNATIVE
NEW BEDFORD HARBOR SITE, NEW BEDFORD, MA
NOT TO SCALE

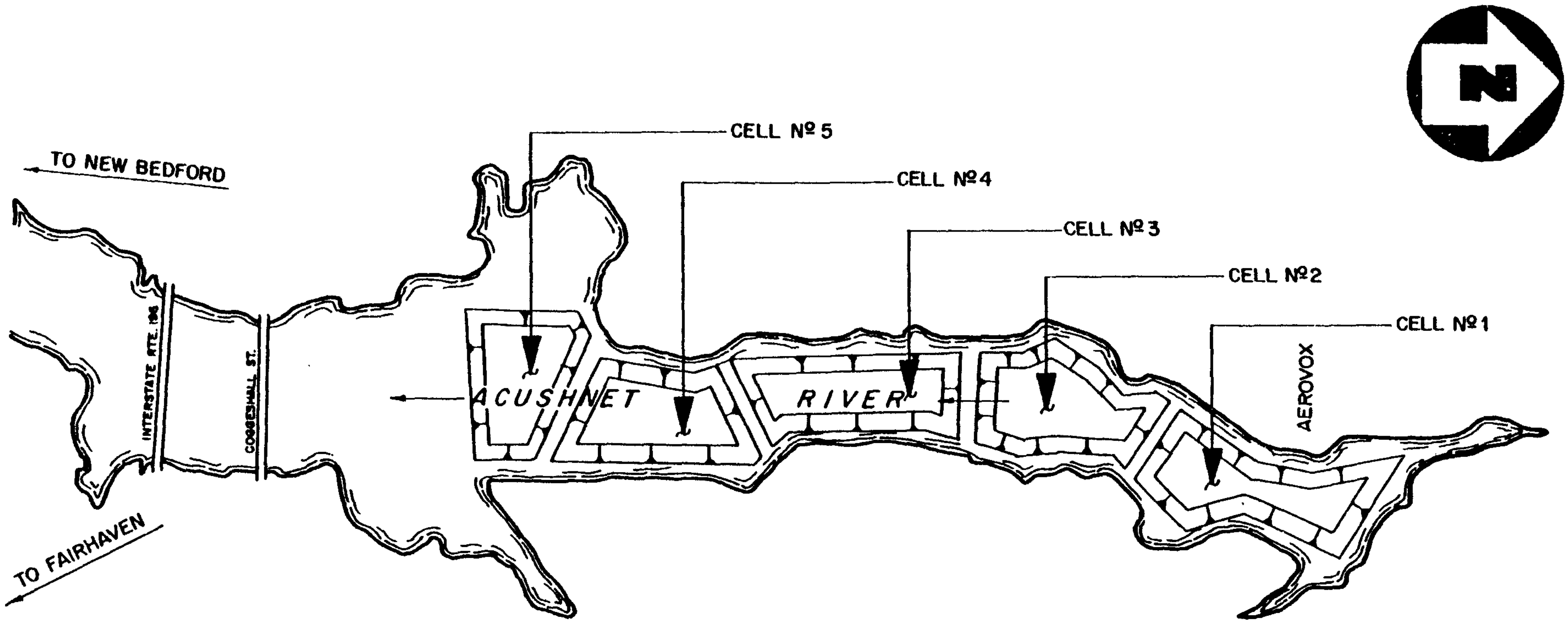
NUS CORPORATION
A Halliburton Company



PLAN VIEW ILLUSTRATING PORTION OF HARBOR SUITABLE FOR CELL DEVELOPMENT SUBSURFACE DISPOSAL ALTERNATIVE NEW BEDFORD SITE, NEW BEDFORD, MA

FIGURE 2-4

NUS CORPORATION
A Halliburton Company



NOTE: CAPACITY OF EACH CELL IS APPROXIMATELY 200,000 CU. YD.

0 1000 2000

SCALE IN FEET

PLAN VIEW ILLUSTRATING DISPOSAL CELL LOCATIONS
SUBSURFACE DISPOSAL ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

FIGURE 2-5

NUS CORPORATION
A Halliburton Company

The entire dredging and cell development procedure can be broken down into 13 substeps, as follows:

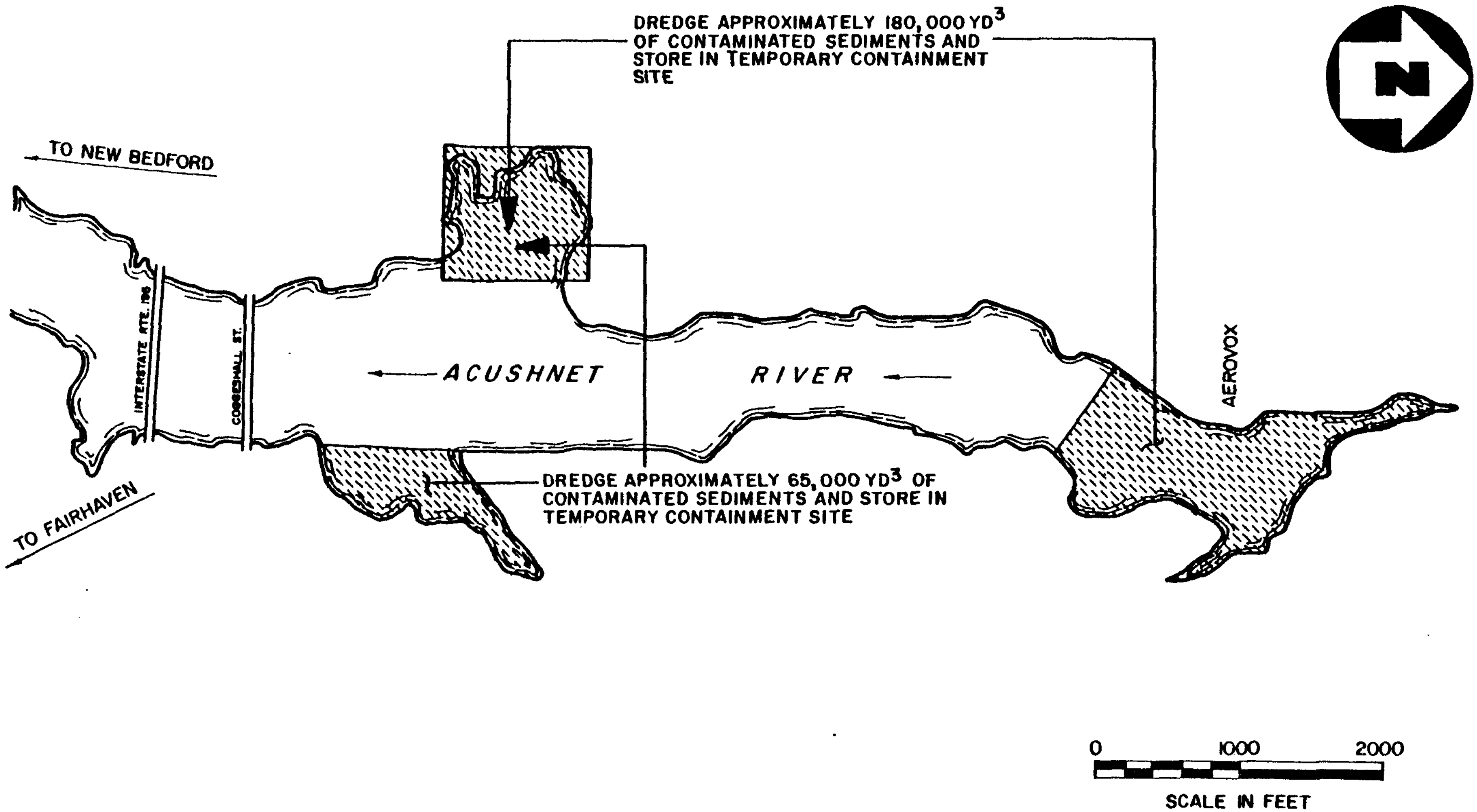
Substep 1 - Contaminated sediments will be dredged from beneath the proposed location of the temporary containment site for clean sediments on the east side of the harbor. The sediments will be dredged to an estimated depth of 3 feet, and discharged directly into the temporary containment site for contaminated sediments on the west side of the harbor, as shown on Figure 2-6.

Substep 2 - Contaminated sediments will be dredged from the northern end of the upper harbor. The dredging operation will proceed in a southerly direction, until enough contaminated sediments (approximately 180,000 yd^3) are removed to allow for the dredging and development of the first disposal cell. Dredged sediments will be discharged into the temporary containment site on the west side of the harbor, as indicated on Figure 2-6.

Substep 3 - Approximately 200,000 yd^3 of clean sediments will be dredged from the northern end of the upper harbor in order to develop the first disposal cell. The cell will be constructed as previously presented on Figure 2-3, with a final dredging depth of approximately 13 feet (3 feet of contaminated sediments and 10 feet of clean sediments). Dredged sediments will be discharged directly into the temporary containment site on the east side of the harbor. Figure 2-7 depicts the development of the first disposal cell.

Substep 4 - Approximately 200,000 yd^3 of contaminated sediments will be dredged from the upper harbor, starting immediately downstream of the area dredged in Substep 2 and will proceed in a southerly direction. Dredged sediments will be discharged into the first previously developed in-harbor disposal cell, as shown in Figure 2-8.

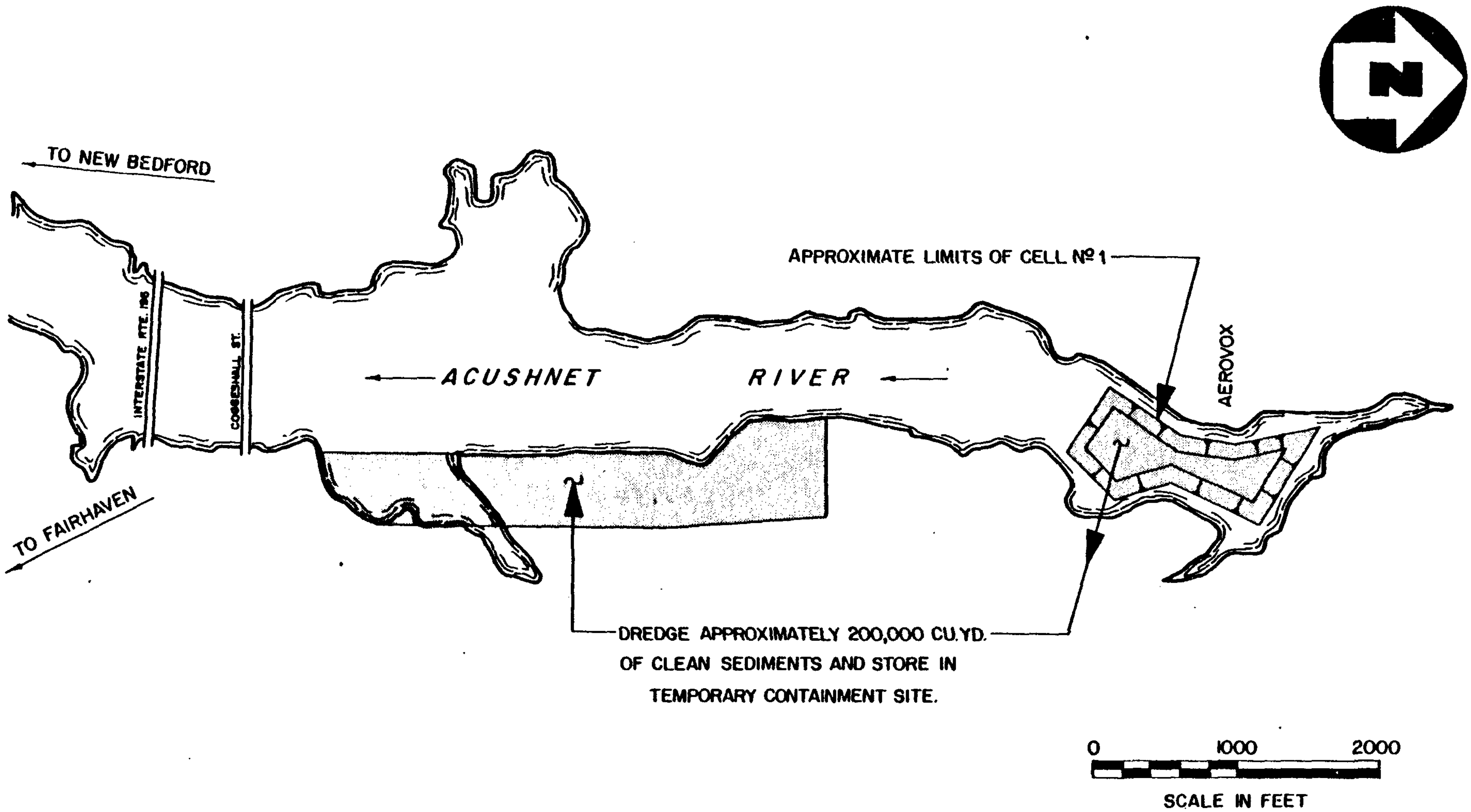
Substep 5 - Approximately 200,000 yd^3 of clean sediments will be dredged in order to develop the second disposal cell. Cell excavation will begin at a point about 100 feet south of the first containment cell, as shown in Figure 2-9.



SUBSTEP 1 & 2
SUBSURFACE DISPOSAL ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

FIGURE 2-6

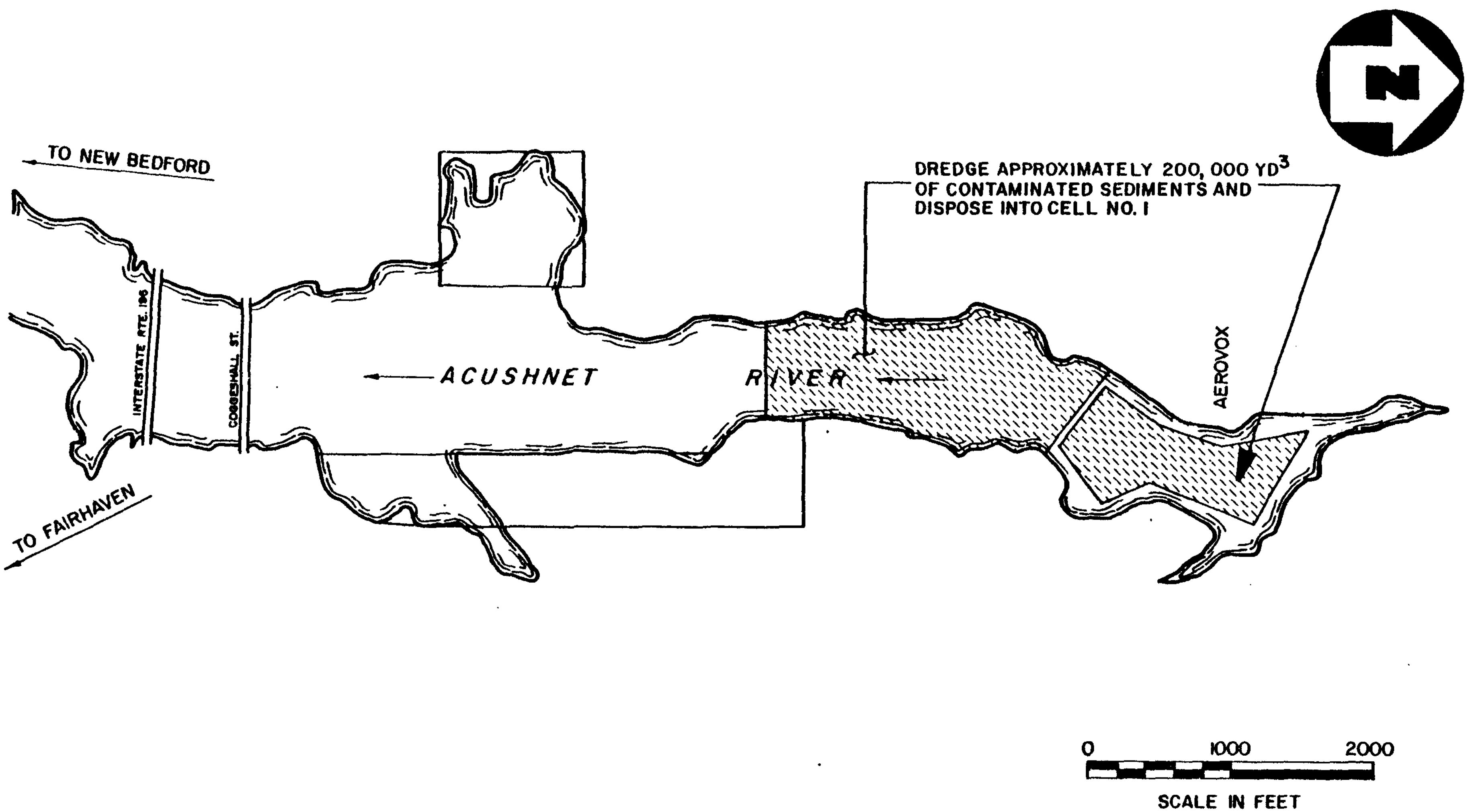
NUS CORPORATION
A Halliburton Company



SUBSTEP 3
SUBSURFACE DISPOSAL ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

FIGURE 2-7

NUS CORPORATION
A Halliburton Company



SUBSTEP 4
SUBSURFACE DISPOSAL ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

FIGURE 2-8

NUS CORPORATION
A Halliburton Company

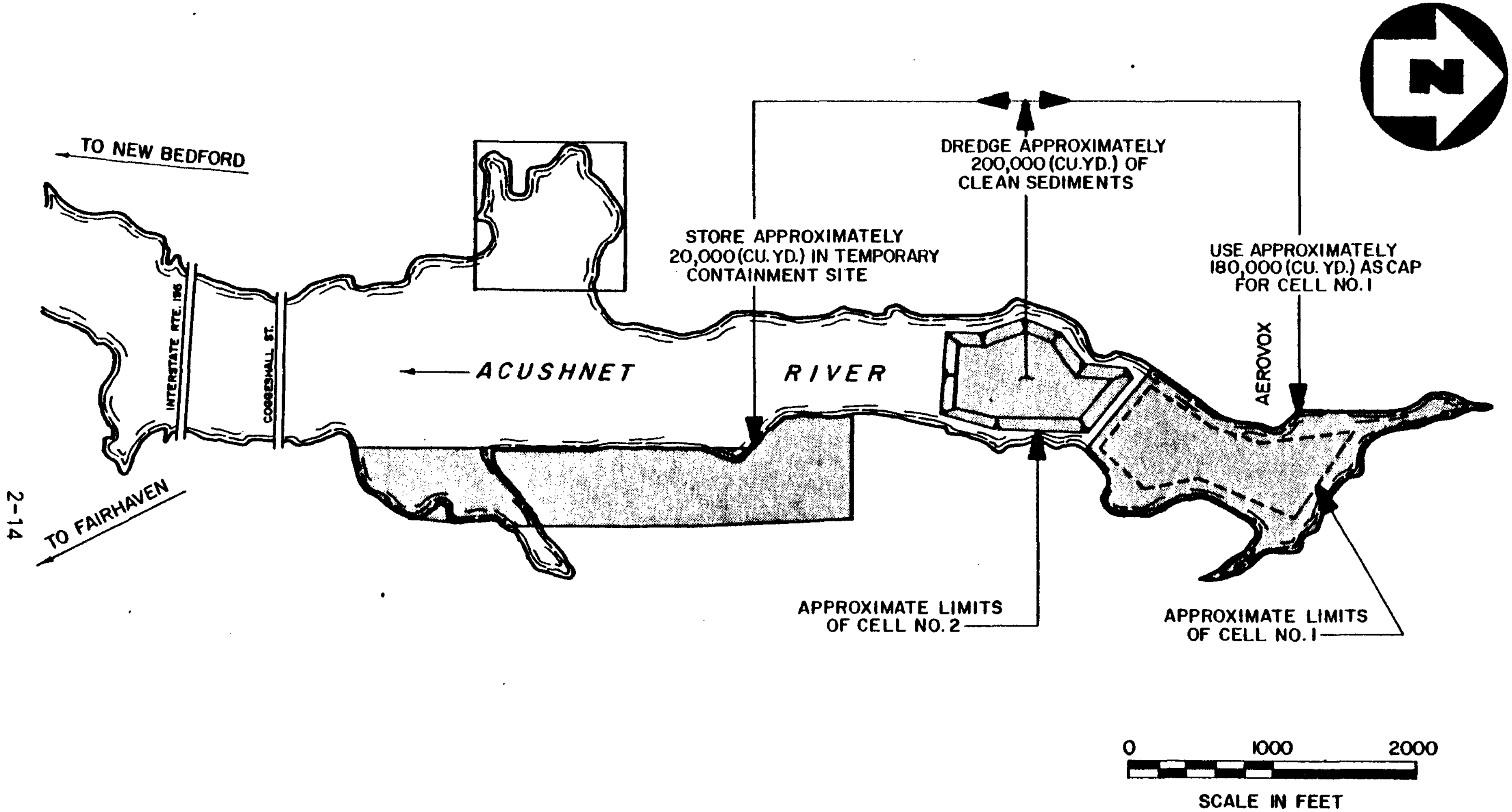


FIGURE 2-9

SUBSTEP 5
SUBSURFACE DISPOSAL ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

NUS CORPORATION
A Halliburton Company

Approximately 180,000 yd^3 of the clean dredge spoil will be discharged onto the top of the first cell, resulting in a 3-foot-thick sediment cap overlying the contaminated cell contents. Figure 2-10 presents a typical cross section of a disposal cell after filling and capping. The remaining 20,000 yd^3 of clean sediments will be discharged into the temporary containment site on the west side of the harbor.

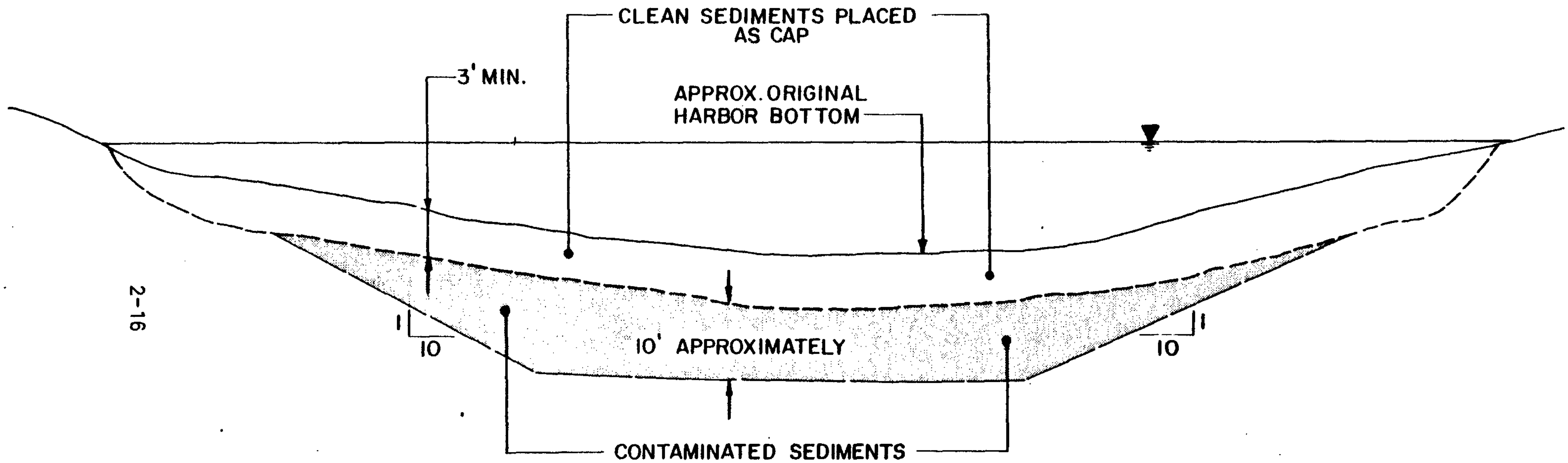
Substep 6 - Roughly 200,000 yd^3 of contaminated sediments will be dredged from the northernmost contaminated area remaining in the upper harbor. Dredge spoils will be discharged into the second disposal cell.

Substep 7 - Approximately 200,000 yd^3 of clean sediments will be dredged (at the location shown on Figure 2-5) in order to develop the third disposal cell. Roughly 125,000 yd^3 of the clean sediments will be used as a cap for the second cell, while the remaining portion will be stored in the temporary containment facility on the east side of the harbor.

Substep 8 - Approximately 200,000 yd^3 of contaminated sediments will be dredged from the northernmost contaminated area remaining in the upper harbor. These contaminated materials will be placed directly into the third disposal cell.

Substep 9 - Roughly 200,000 yd^3 of clean sediments will be dredged (at the location shown on Figure 2-5) in order to develop the fourth disposal cell. Approximately 135,000 yd^3 of the clean sediments will be used as a cap for the third cell, and 65,000 yd^3 will be discharged into the temporary containment site on the east side of the harbor.

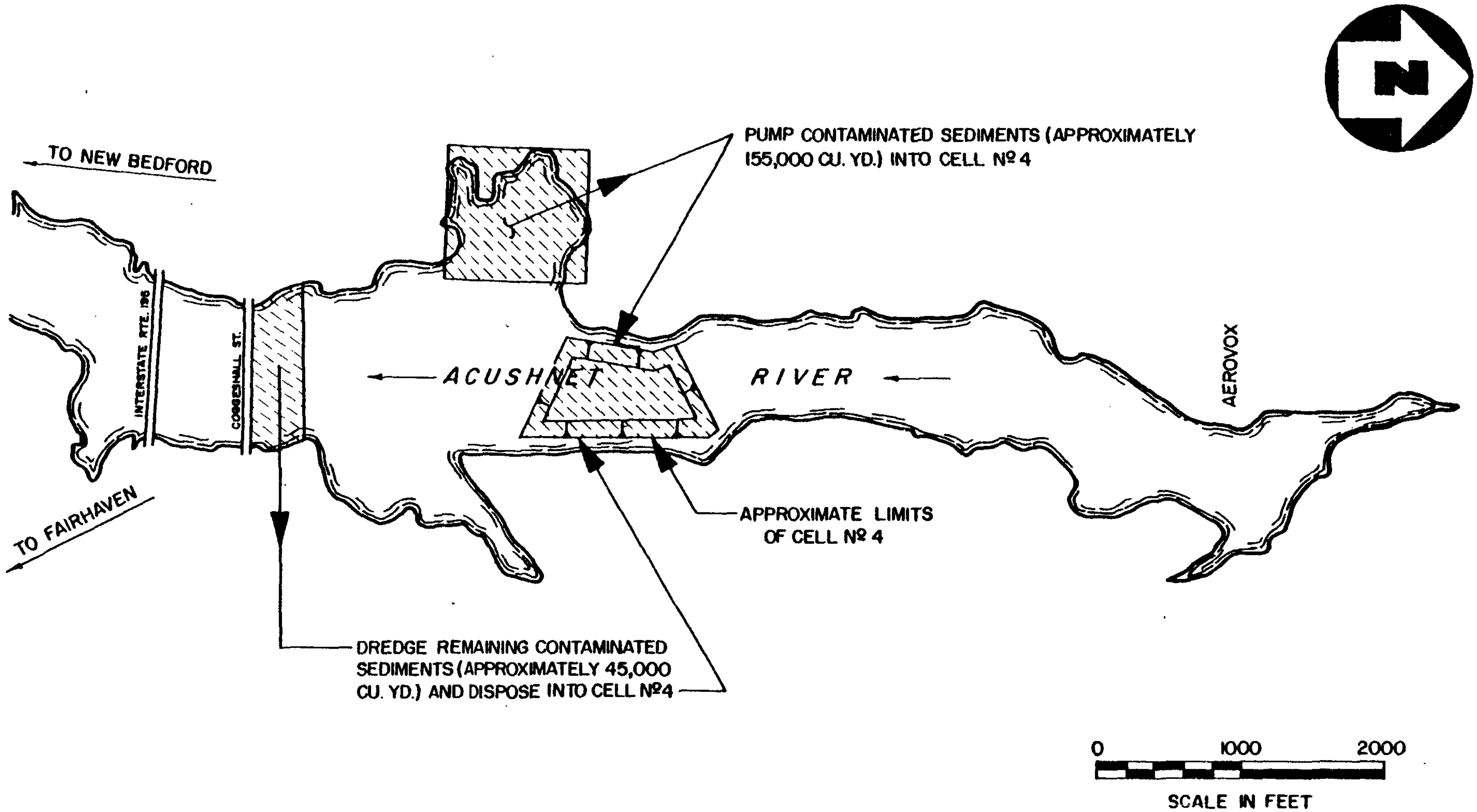
Substep 10 - The remaining contaminated sediments will be dredged from the southernmost portion of the harbor and discharged directly into the fourth disposal cell. Additional contaminated sediments from the temporary storage area on the west side of the harbor will be hydraulically transported by the pipeline to the fourth cell until the cell is filled. The procedure is depicted on Figure 2-11.



TYPICAL CROSS SECTION
DISPOSAL CELL AFTER COMPLETION
SUBSURFACE DISPOSAL ALTERNATIVE
NOT TO SCALE

FIGURE 2-10

NUS CORPORATION
A Halliburton Company



SUBSTEP 10
SUBSURFACE DISPOSAL ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

FIGURE 2-11

NUS CORPORATION
A Halliburton Company

Substep 11 - Approximately 200,000 yd^3 of clean sediments will be dredged in order to develop the fifth and final disposal cell, to be located at the position shown on Figure 2-5. The fourth disposal cell will be capped with approximately 120,000 yd^3 of the clean dredge spoil. The remainder of the clean spoil will be transported to temporary containment on the east side of the harbor.

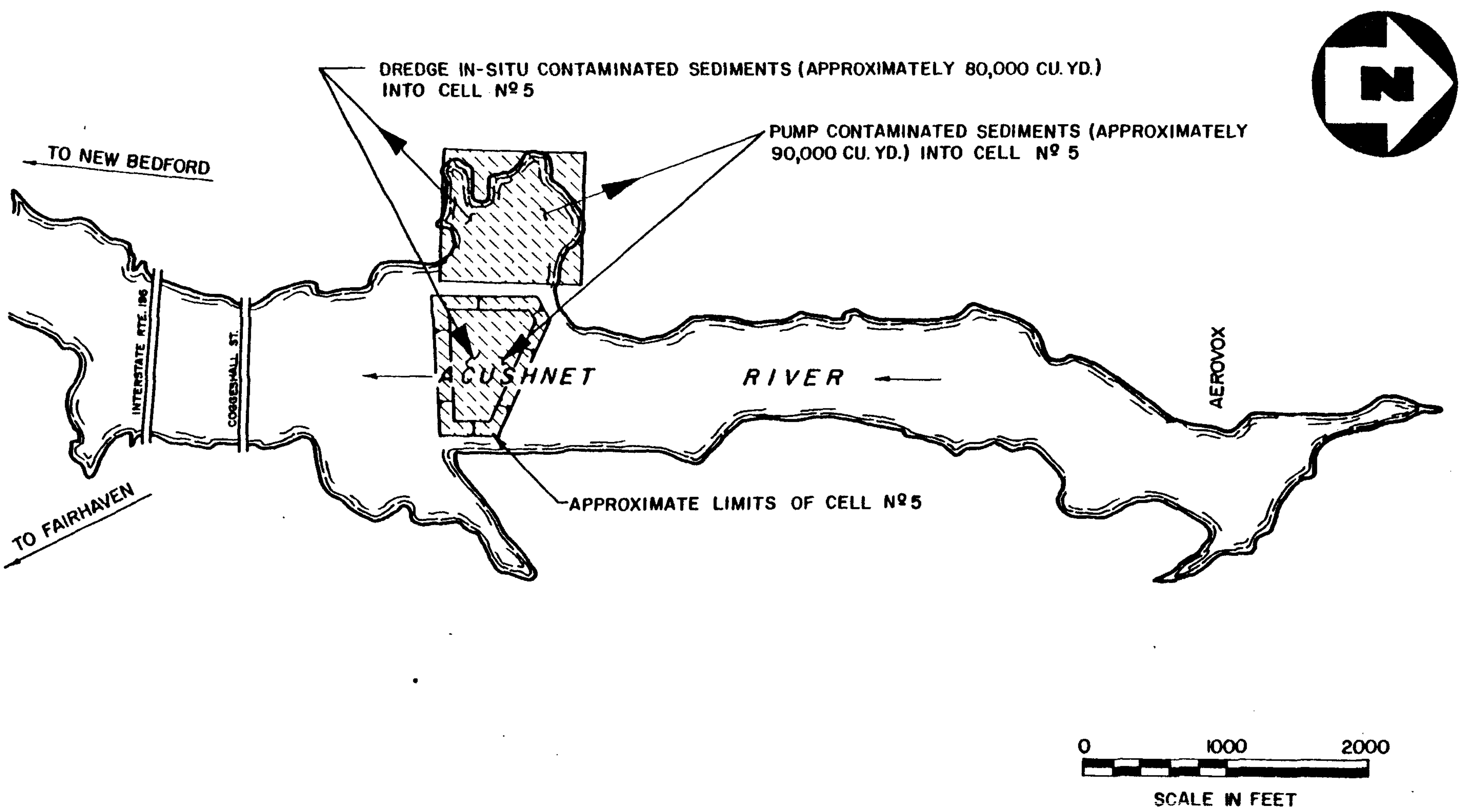
Substep 12 - All contaminated sediments remaining in temporary containment on the west side of the harbor will be hydraulically transported by pipeline to the fifth disposal cell. In-situ contaminated sediments on the bottom of the temporary containment site on the west side of the harbor will also be dredged and disposed directly into the fifth disposal cell, as shown on Figure 2-12.

Substep 13 - All clean sediments remaining in temporary containment on the east side of the harbor will be hydraulically transported to cap the remaining uncapped portion of the upper harbor, including:

- The fifth disposal cell
- The former locations of the temporary containment sites
- The unused portion of the upper harbor near the Coggeshall Street Bridge.

This procedure is depicted on Figure 2-13.

The proposed dredging program as outlined above is preliminary in nature and may be modified significantly during the final design phase as more detailed information becomes available, e.g., property ownership and boundaries, large-scale topographic mapping, subsurface conditions, etc. Final design will require a thorough investigation to locate utility lines, if any, on the harbor bottom and harbor edges. Final design will further refine dredging depths and the type, size, and location of temporary containment sites and disposal cells. Detailed engineering studies may determine that the size of the containment site on the eastern shoreline can be decreased by clean sediment storage within the harbor.



SUBSTEPS 12
SUBSURFACE DISPOSAL ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

FIGURE 2-12

NUS CORPORATION
A Halliburton Company

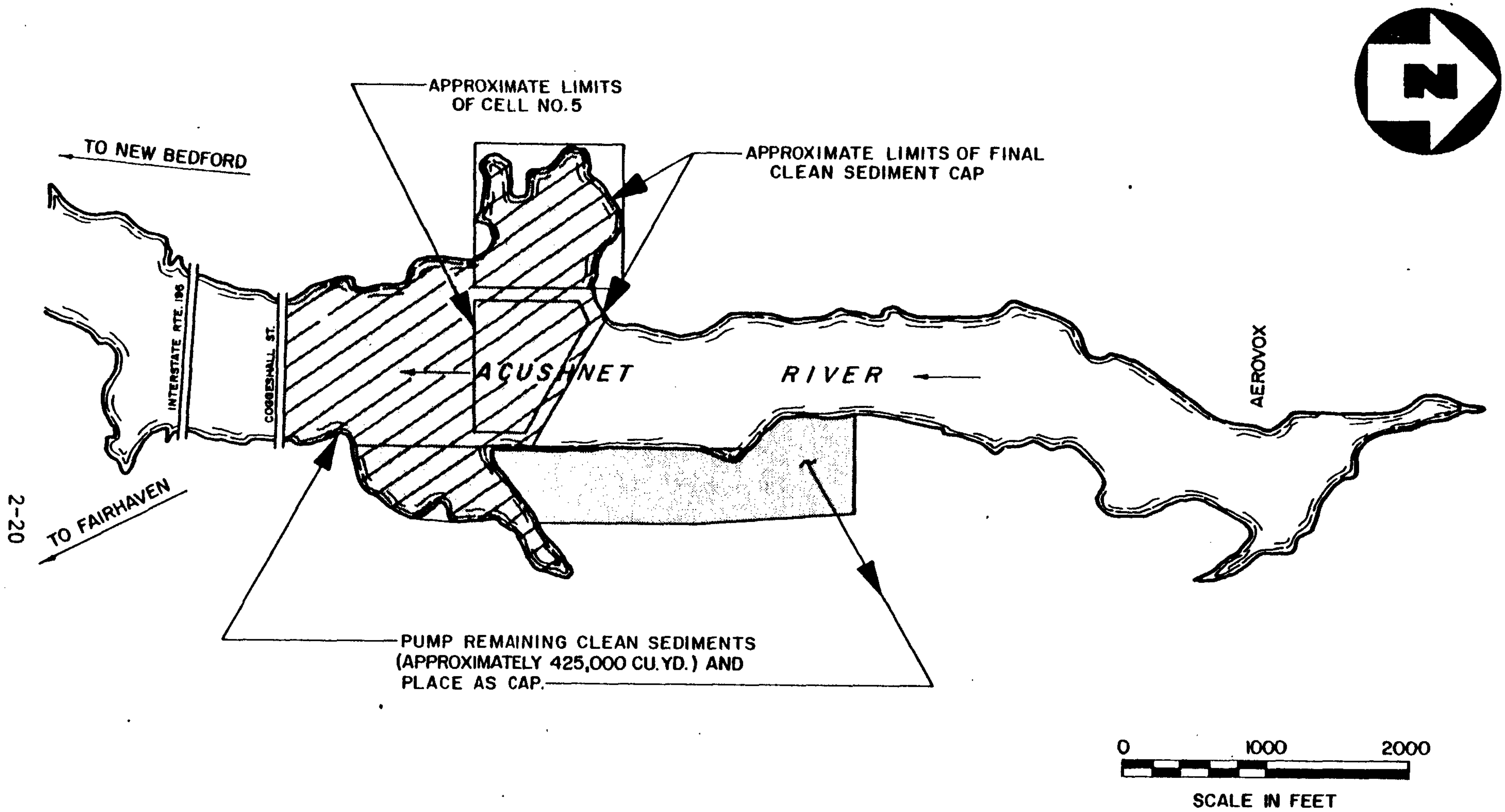


FIGURE 2-13

SUBSTEP 13
SUBSURFACE DISPOSAL ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

NUS CORPORATION
A Halliburton Company

The proposed concept is quite flexible in terms of areal extent and depth of dredging, as well as the location and sizing of temporary containment sites.

Step 5: Treat Water

Water to be treated will be collected from the temporary containment site for contaminated sediments on the west side of the harbor (Figure 2-1). This water will include:

- Surface water within the containment site. This surface water was originally a portion of the harbor water body and was subsequently trapped upon construction of the containment site.

- Supernatant water from the dewatering of the dredge spoils.

- Direct precipitation on the temporary containment site.

Since this water will contain potentially contaminated suspended solids, all of the water will be decanted from the surface of the containment site and transferred by pumps and pipeline to a treatment plant. The major components of the treatment plant will include a flow equalization tank, chemical addition tank, clarifier, and filters filled with Klensorb and activated carbon. Baffles will be added to the flow equalization tank for grit removal. Design flow rates will depend on both the dredging rate and the storage capacity of the containment site. The overall plant design is dependent on the contamination types and levels found in the water, and both bench and pilot-scale studies will be required for final design.

Step 6: Remove Temporary Containment Site Embankments

In order to return the site to original grade and to reestablish the wetland environments, the embankments constructed for the temporary containment sites should be removed. Accordingly, the earthen materials would be loaded onto trucks for offsite hauling. The possibility of using some or all of the embankment material as fill in the harbor area should be investigated during final design. Also, responsibility for restoration of the wetlands, vegetation, etc., should be resolved during the final design.

2.2 Evaluation of Cost-Effectiveness

The purpose of this section is to provide detailed discussions of the beneficial and *adverse effects associated with the alternative of dredging contaminated* sediments with disposal in in-harbor, subsurface cells. Environmental, public health, and public welfare and community effects are treated in Sections 2.2.1 through 2.2.3, respectively. Section 2.2.4 addresses several other cost-effectiveness measures, while Section 2.2.5 presents a summary of project costs. Since many of the features of this alternative are similar to those of the other proposed alternatives, several sections of the draft report are repeated in this section with appropriate revisions.

2.2.1 Environmental Effects

This remedial action alternative involves the following actions: sediment dredging; temporary storage of both contaminated and clean dredged materials (including embankment construction); dewatering; water treatment; and placement of the dredged materials back into the subsurface cells. The specific environmental impacts of each are addressed below.

Effects of Dredging

The use of sediment dispersal controls at the Coggeshall Street Bridge and in the immediate vicinity of the dredging operation will minimize adverse impacts on aquatic life downstream of the construction area. PCBs will generally remain bound to particulate matter that will be effectively contained by the sheet piling and silt curtains. Any increased water column concentrations resulting from dispersal and resolubilization will not be significant in relation to the overall effects on aquatic biota. A primary concern is the dispersal of heavily contaminated oily films from the hot-spot areas. The silt curtains will provide a partial barrier to the downstream migration of these films, particularly if the silt curtain is modified to incorporate some type of absorbent material. The Site Operations Plan must include a quick removal of any collected films from the silt curtains to minimize subsequent dispersal and photolysis. The metals are expected to remain as insoluble metal sulfides since the time of particulate transport prior to resettling will not be sufficient to oxidize the sulfides.

Within the actual dredging area, short-term adverse impacts are expected. Sediment dredging will remove the existing substratum and destroy the benthic community, but the resultant ecological effects will not be severe, since the bottom populations are currently sparse as a result of the high levels of contamination. The long-term effects should be beneficial because the disposal of contaminated sediments beneath a cap of clean sediments will provide a favorable substratum upon which aquatic communities can reestablish themselves.

Fish and some aquatic invertebrates, because they are mobile, would leave the area being disturbed by dredging. Upon completion of the project, these populations could eventually return, although it is possible that different communities would be established because of the improved environmental conditions.

Dredging would also affect terrestrial biota. Populations of fish-eating birds and mammals that currently reside and feed in this section of the river would leave as noise and human activity increase. If none of these species breed in the area, no long-term displacement of individuals would be expected. After construction is complete, these terrestrial species would return to feed on the new, healthy fish population that becomes established in the estuary.

Dredging of the hot-spot areas will necessarily include the salt marshes along both shorelines because of their location within the areas of highest PCB concentrations. The disruption of the marshes will be temporary, however, since the "refilling" of the dredged cells will restore the shallow water areas and allow for the reestablishment of the marshes in a clean environment.

The two principal beneficial impacts of dredging are the consequent reductions in PCB concentrations in the water column and reduced PCB accumulations in fish. The downstream movement of PCB-contaminated sediments would also be eliminated and would thereby result in benefits to the overall aquatic community in New Bedford Harbor.

Effects of Temporary Sediment Storage Areas (Western and Eastern Coves)

Constructing retaining embankments and filling both the western and eastern coves as temporary sediment storage areas will destroy the existing marsh communities. However, once the stored sediments and the underlying contaminated sediments are removed to subsurface cells, a clean substratum would be left upon which new communities can build. Because the existing communities that have been established in the cove and the mudflats have been impacted by the high levels of PCBs and metals, the long-term effects of this activity would be beneficial. This scenario assumes that the embankments are removed upon completion of the project so that the coves are not permanently cut off from the estuary. Even if the embankments are removed, the loss of the marsh environment will take several years to reverse, and the recovery process may not be readily noticed.

Effects of Dewatering

The dewatering of sediments under this alternative will be incorporated into the overall construction and operation of the temporary sediment storage areas. Three specific environmental concerns associated with the dewatering operation are the potential (though limited) volatilization of PCBs as the sediments become exposed upon dewatering, the possible oxidation and mobilization of metals in the upper zones if exposure to the atmosphere is maintained, and the existence of a free water surface that could attract waterfowl and mammals to contaminated areas. Note that these concerns are only applicable to the temporary storage of contaminated sediments in the western cove. Only clean sediments will be stored along the eastern shore.

Effects of Water Treatment

Supernatant from the dewatering operation at the western cove will be processed through a package water treatment plant. The water should be treated to PCB levels below 1 ppb, and the effluent will be discharged to the harbor. Discharge to a municipal sewer system is possible, but the high flow rate and salinity of the water may impose irreconcilable constraints on this option. The treatment of supernatant water will considerably reduce the potential health risks and environmental impacts of the dewatering and disposal operation. A small parcel of land will be needed for the water treatment facility and discharge pipe easement. This land will be removed from other uses until the cleanup is complete, at which time the plant will be dismantled. No permanent adverse impacts would result from the construction and operation of the water treatment facility.

Effects of Placing Dredged Sediments into Subsurface Cells

The greatest potential consequence of pumping the contaminated and clean sediments back into the subsurface cells is the resuspension and dispersion of the pumped materials to areas outside the cells. The potential for a significant effect is small, however, since the sediments are primarily silts and silty sands that should quickly settle in the immediate vicinity of the operation. In addition, three features have been specifically incorporated into this operation to minimize the amount and effects of sediment resuspension and dispersal. These include:

- The proposed sheet pile barrier and silt curtain at the bridge opening and other localized use of silt curtains

- The proposed use of a submerged discharge pipe that will release sediments directly into the bottom of each cell rather than at or above the water surface

- The proposed method of cell construction, which leaves a natural barrier of clean sediments between each pair of cells, and thereby in effect forms a settling basin within each cell.

A related concern is the possible release of contaminated water from the sediments as they are discharged and settle into the cells. Any water so generated cannot be feasibly collected or treated. The resultant effects, however, should not be significant since the PCBs and metals are expected to be highly immobile within the sediments, and the small amount of water released from the contaminated sediments will be quickly diluted by the tidal and freshwater flows. This condition will also be very short-term, since capping by several feet of clean sediments will inhibit the release of pure water from the buried contaminated sediments.

By not lining the subsurface cells, groundwater will be free to move through the disposed materials. It is unlikely, however, that groundwater flows will significantly mobilize the PCBs and metals even if the flows pass through the cells. Anoxic conditions and metal insolubility are expected to be maintained, and any contaminants that are mobilized can be expected to become bound in the nearshore or bottom materials so that the ultimate extent of migration will be limited. The effects of any groundwater contamination will not be significant, since the potential extent of contamination will likely be limited to areas with saline groundwater that are not groundwater usage areas.

The use of subsurface disposal cells has two principal environmental benefits in comparison with other proposed alternatives. First, there would be no permanent loss of wetlands along the eastern shoreline as would be the case with an in-harbor disposal site. Second, there would be no permanent loss of open water areas or cove areas, as would result if the contaminated sediments are simply capped in place by clean materials (i.e., the hydraulic control with sediment capping alternative).

2.2.2 Public Health Effects

The overall risks to public health currently posed by the contaminated sediments will be effectively mitigated under the alternative of dredging with disposal in in-harbor subsurface cells. Upon project completion, the following conditions should be satisfied:

- The contaminated sediments within the upper estuary will be covered by a clean cap so that direct contact with highly contaminated materials will be prevented.

- The contribution of contaminants to the food chain that initiates in the benthic organisms and bottom feeders will be eliminated.

- The release of PCBs to the atmosphere and the related airborne contaminant exposure will be eliminated.

The risk to humans posed by contaminated fish and shellfish will continue for a period of time until the organisms cleanse themselves through natural processes. The rate of depuration is species-dependent, and is being investigated in a companion study. It is expected that at least several years will be required before the heavily contaminated species in the estuary will satisfy the current FDA level of 2 ppm for PCBs. This period of time will be lengthened for migratory species, since sediments and the overall food chain below the Coggeshall Street Bridge may remain affected by local contamination.

The risk of failure posed by this alternative is low if the temporary embankments and subsurface cells are properly engineered and constructed. The most likely failure mechanism would be an alteration of the sediment cap as a result of natural processes (e.g., extreme wind and wave conditions), future disruptions by individuals (e.g., unlawful dredging), or vandalism. The potential for a failure to the point of exposing the contaminated sediments is low; however, and the effects would be minimal because of the localized nature of a failure. A straightforward remedy is also in effect under this alternative, since it would simply require a localized replacement of the cap. Note that no contaminated sediments would be disposed in the deeper portions of the estuary near the bridge. This not only reduces the risk of scouring the cap but also promotes an effective monitoring of cap integrity, since most critical areas would be in shallow water.

Even though this alternative will not isolate the contaminants from the underlying groundwaters, the chemical nature of the PCBs and metals will inhibit their mobilization and their transport into the groundwater system. If any migration does occur, the related public health impacts will be minimal because these groundwater zones are saline and are not currently used for consumption.

The public health risks associated with dredging activities will likewise be minimal. The sediments being dredged and replaced in the cells will be in a wet state throughout the construction period to minimize airborne releases. In addition, the proposed sheet pile barrier and silt curtain at the bridge opening and the localized use of silt curtains (if necessary) will reduce the risk of contaminant migration. Workers will be operating from land- or water-based equipment and will not be in direct contact with the contaminated sediments. Proper personal protection is readily available if deemed necessary, as for example, dermal protection from splashing when operating in shallow water areas.

Dredging or embankment construction in the highly contaminated areas is expected to disturb PCB-laden oily films on the sediments. The dispersion of these substances can be at least partially controlled by silt curtains and absorbents or other types of techniques used for oil-spill control. Nevertheless, the presence of these films on the water surface would increase the potential for PCB dispersal and volatilization. Site operations must therefore include the periodic collection and disposal or treatment of any material or substance entrained by the dispersal control structures.

The need to temporarily store contaminated sediments in the western cove area in close proximity to populated areas creates an increased risk of exposure. Because the temporary storage area must be constructed at least partially above the existing ground surface, a drying of the upper layers could occur over the period of temporary storage and would consequently increase the potential for airborne contamination. Public access to the dredging and storage areas would be prohibited.

2.2.3 Public Welfare and Community Effects

As with the other four remedial action alternatives, the alternative under study will isolate the PCBs and metals in the Acushnet River Estuary upstream of the Coggeshall Street Bridge so that their transport to the harbor and bay is prevented. This will avoid the compounding of the contamination already in the harbor and bay, and will thus reduce the severity of impacts to public health, public welfare, and the environment. Each alternative will likewise result in improved environmental and water quality conditions to increase property values and to promote recreational and other usage of the estuary.

An economic benefit that is common to all remedial action alternatives is the employment opportunities created by the project. These opportunities would temporarily reduce unemployment in the New Bedford area, even though unemployment would return to a pre-cleanup level when the project is completed.

When compared with the other proposed remedial action alternatives, the alternative of sediment dredging with disposal in in-harbor subsurface cells has fewer adverse effects on the adjacent communities. With the exception of the temporary storage embankments, no components require raw materials from off site. This will minimize truck traffic, noise levels, and fugitive dust emissions in relation to the other alternatives. There will also be no need to relocate or extend any industrial outfalls to the estuary. Submerged utility lines crossing the estuary will likely not require relocation, since the configuration of the cells can be modified to incorporate such crossings in the undisturbed, clean sediment barriers that form the walls of the cells.

Because the configuration of the estuary will not be modified under this alternative, any adverse effects to waterfront properties would be limited to the period of construction. In fact, property values would be expected to increase upon project completion owing to the restoration of the estuarine environment. Further study will be required to determine the type and level of recreational activity that could be permitted in the areas underlain by the contaminated sediments in the cells. Note that the area nearest the Coggeshall Street Bridge, where most residential and commercial development of the waterfront is located, will not be underlain by contaminated sediments.

2.2.4 Miscellaneous Cost-Effectiveness Measures

Level of Cleanup and Isolation Achievable

Practically speaking, the alternative of dredging contaminated sediments with disposal in subsurface cells will achieve isolation of the PCBs and metals in the hot-spot areas. A small percentage of the contaminants will remain in the sediments because of an inherent inefficiency in the segregation of clean and contaminated sediments. The average concentration of PCBs remaining in the estuary sediments should, on the average, be less than the most stringent target value of 1 ppm. A similarly effective removal and/or isolation of heavy metals will concomitantly be achieved.

The assumed 3-foot depth of contaminated sediments is based on both the estimated depth of sediment that would have been deposited since the initiation of PCB use in the New Bedford area (with an appropriate factor of safety) and the observed decrease in PCB levels with depth in deep sediment samples. A basic assumption made in the development and evaluation of this alternative is that the sediments below a 3-foot depth are "clean" of all contaminants. It is recognized, however, that earlier industries may have used other chemicals in their operations that would underlie the PCBs in the sediments. It is therefore anticipated that, if this alternative is subsequently favored as a remedial action for the hot-spot areas, additional chemical testing of deep cores will be necessary.

Acceptability of Land and Water Use after Action

Upon project completion, the alternative under study will not result in significant changes in land and water use. By returning the estuary to an acceptable environmental condition, water-based recreation and other uses would be expected to increase. This is offset in the present case, however, by the potential imposition of restrictions on the use of the estuary waters in order to permanently protect the integrity of the disposal cells.

Additional dredging of contaminated sediments may be found in a subsequent feasibility study to be a cost-effective action for remediation of other portions of New Bedford Harbor. Disposal of these sediments will again be a critical issue. The only way that additional storage could be gained if this alternative is implemented would be to open up additional cells near the bridge. Such an action would require both special wall construction in order to fill in the deeper portions of the estuary, and special hydraulic control structures and cap protection measures to protect against scour in areas near the bridge.

Time Required to Achieve Removal and Isolation

The estimated time required to achieve isolation of the PCBs and metals in the hot-spot areas by implementing the alternative of sediment dredging with disposal in in-harbor subsurface cells is 4 years. This time estimate may be approximately 25 percent longer to allow for appropriate planning and design, as well as to account for poor weather and logistical difficulties.

2.2.5 Estimated Costs

Costs for the completion of the alternative of sediment dredging with disposal in subsurface cells are presented in Table 2-1. The costs do not include any long-term costs for groundwater or environmental monitoring programs.

TABLE 2-1

COST ESTIMATE
DREDGING WITH DISPOSAL IN SUBSURFACE CELLS

Cost Element	Cost
Install Sediment Dispersal Control	$ 155,200
Construct Temporary Containment Site for Contaminated Sediments	1,351,400
Construct Temporary Containment Site for Clean Sediments	1,726,800
Dredge Contaminated Sediments	5,400,000
Dredge Clean Sediments	5,400,000
Transport Contaminated Sediments from Containment Site	490,000
Transport Clean Sediments from Containment Site	850,000
Treat Water	1,701,100
Remove Temporary Containment Embankments	752,900
SUBTOTAL	**$ 17,827,400**
Health and Safety Monitoring	$ 713,100
Level D Working Conditions	924,000
Contingency 22%	3,892,900
Overhead and Profit 12.5%	2,335,700
Engineering 20%	3,854,000
TOTAL	**$ 29,547,100**

3.0 INCINERATION OF PCB-CONTAMINATED SEDIMENTS

3.1 Review of Initial Screening of Incineration Alternatives

Incineration of the PCB-contaminated sediments was previously proposed as an alternative in the Fast-track Feasibility Study for the Acushnet River Estuary. The Fast-track Feasibility Study was performed within a time frame that did not permit the completion of a full Remedial Investigation, although considerable information did exist to perform an adequate determination of remediation needs. The development and evaluation of incinerator designs and support actions were, therefore, completed solely from existing information. No treatability studies or other testing were performed.

Incineration of PCBs and PCB-contaminated materials has received increased attention because of the regulations governing the land disposal of PCBs. In particular, a PCB liquid that has a concentration of PCBs in excess of 500 ppm cannot, according to current regulations, be landfilled. The fact that the liquid must be incinerated or destroyed by an EPA-approved chemical process has created an increased demand for incinerators that are approved for PCB destruction. At least 57 companies are actively marketing incinerators that are suitable for hazardous waste destruction, including PCBs. Some of the units that are being marketed can be used as designed or can be easily modified to decontaminated dredged sediments. These units include fluidized bed, rotary kiln, multiple hearth, and multiple chamber incinerators. All of these incinerators have been used for commercial waste destruction for a number of years. There are currently, however, only three incinerators permitted in compliance with the requirements of the Toxic Substances Control Act (TSCA) for the incineration of PCB-contaminated solids. These three units are nonmobile, and are located in Texas, Arkansas, and Illinois. They are all rotary kilns that can be used to incinerate sediments as well as PCB liquids, and each has been approved by the EPA for the incineration of PCBs in sediments.

The rotary kiln incinerator has proven to be a very flexible unit that can withstand the rigorous conditions required for PCB destruction much better than other types of incinerators. One reason is because the constant rotating refractory surface can resist the high temperature requirements while providing maximum exposure of all of the materials to the destruction temperatures. In addition, this incinerator has been extensively used in other applications for the treatment of troublesome, variable solid wastes. Other incinerators cannot handle the nonuniformly sized materials that can be expected in harbor sediments. Because the rotary kiln unit has been approved by the EPA, approval of similarly designed units in the future is likely.

The use of an existing, approved, rotary kiln incineration facility would involve shipping the sediments to the facility for treatment. The advantage of this action is that the time required for the construction and approval of a new incinerator would be eliminated. However, transportation of the wastes to the facility would produce a large economic disadvantage. The closest approved facility is located in Illinois, approximately 900 miles away. In addition, the material would require supplementary fuel for incineration, a requirement that does not appear favorable to the owners of private incineration facilities. This option was therefore eliminated in the initial screening of technologies.

By using a mobile rotary kiln incinerator on site, problems associated with the transportation of large volumes of contaminated sediments would be eliminated. Another advantage of using mobile rotary kilns is that they can be set up on site, and when decontamination of the sediments is complete, they can be dismantled and removed. A critical disadvantage of using mobile incinerators is that, because these units must be small enough to be transportable, numerous units would be required to complete the decontamination within a reasonable period of time. Another problem is that, although a mobile unit can be approved by the Regional Administrator of the EPA, extensive testing is required. Each incineration unit would have to undergo individual testing and permitting, which would undoubtedly be a costly and time-consuming task. The mobile unit option was therefore eliminated during the initial screening phase of the Feasibility Study.

A stationary incineration unit constructed on site would be entirely dedicated to the incineration of New Bedford Harbor sediments. It would be a much larger unit than a mobile unit and would thereby reduce the number of units required. One large unit would be more economical to construct, and would more efficiently decontaminate the sediments while also requiring less fuel, labor, and maintenance. Testing and permitting costs would be reduced since a single large unit would be significantly easier to test and permit than numerous smaller ones. The onsite incinerator would not be without its disadvantages, however. There would be no mechanism for renting or leasing such a unit; therefore, a large initial capital outlay would be required. Since the unit would have to be purchased, the only way to defray the capital cost would be through its depreciation and salvaging, and the savings would not be very substantial.

In summary, it was determined during the screening phases of the Feasibility Study that an onsite, stationary rotary kiln incinerator represents the most feasible treatment technology as an alternative to landfilling the PCB-contaminated sediments from the Acushnet River Estuary. (More details of the screening process are found in the draft report.) One of the initial remedial action alternatives included the removal and incineration of all the PCB-contaminated sediments from the estuary above the Coggeshall Street Bridge. Dredged material would first be dewatered and then incinerated. The residue from this operation would be sent to an approved disposal area. A second alternative that was proposed included the incineration of only those sediments with PCB concentrations in excess of 500 ppm. All remaining contaminated sediments would go directly to the disposal area.

3.2 Rotary Kiln Incineration

The rotary kiln proposed for the project is essentially a large, refractory-lined cylinder that rotates on steel wheels. It is sloped from the feed to the discharge end so that the material being fed moves progressively along the length of the unit as the contaminants are being incinerated. Ignition occurs at the front end of the kiln, and combustion progresses until the sediments and unburnable materials are discharged from the low end of the kiln. This section of the incinerator, known as the primary combustion chamber, is where most of the organic materials, including PCBs, are either burned or volatilized. Those gases that exit the primary chamber, consisting mainly of combustion by-products, unburned PCBs, and organic and inorganic materials, enter directly into the afterburner or secondary combustion chamber. The gases are reheated in this section to temperatures which ensure the destruction of all remaining organic vapors. The afterburner is essential because the mixing of the air and the combustible materials in the kiln may not be sufficient to allow for complete combustion. The gases leaving the afterburner are composed mainly of carbon dioxide, nitrogen, water vapor, excess oxygen, and fine ash and sediment particles entrained in the gases.

Since a large amount of noncombustible material would be charged to the incinerator, the particulate concentration in the flue gas is also expected to be high. To counter this, some additional flue gas treatment steps would be required. The high temperatures required and the possible presence of chlorine or hydrochloric acid in the flue gas require the use of a wet scrubber as a primary treatment step. A venturi or packed-bed scrubber would be the most efficient type for removing a high percentage of the undesirable components of the flue gas. If an unusualy high amount of particulates are expected, a mechanical collector such as a baghouse or a cyclone collector could be added. The use of specific air pollution control devices for PCB incineration is regulated in that at least one device must be used that allows for removal of hydrochloric acid.

The final component of an incineration unit is the flue gas elimination system. A induced draft fan or blower located downstream of the flue gas cleanup section, is used to draw the process gases through the unit. Air is drawn, not pushed, through the unit in case any leaks develop in the system. With this method, fresh air is drawn into the unit instead of process gases excaping. Cleaned process gases would be removed from the system via the stack.

3.3 Regulatory Framework

Section 6(C) of the Toxic Substances Control Act (Public Law 94-469), enacted in 1976 required the Administrator of the EPA to establish regulations for the manufacture, processing, distribution, commerce, use, and disposal of PCBs. In May of 1979, the EPA issued a final ruling that included requirements for the disposal of PCBs with concentrations in excess of 50 ppm. The only disposal methods permitted for such PCBs or PCB-contaminated materials were secure landfilling or incineration. Specific regulations were mandated for the incineration of PCB-contaminated materials. The key regulations governing operation of a PCB incinerator are: the incinerator must operate at a minimum of 2200°F with a 2-second dwell time in 3 percent excess oxygen, or at 2900°F with a 1.5-second dwell time in 2 percent excess oxygen. Most of the incinerators designed for PCB incineration allow for incineration at the lower temperature; use of higher temperatures increases kiln wear and fuel consumption. An additional criterion provides for a minimum combustion efficiency standard, which is set at 99.9 percent. The Combustion Efficiency (CE) is calculated by the equation:

$$CE = (CCO_2/(CCO + CCO_2)) \times 100\%$$

CCO = Concentration of carbon monoxide
CCO_2 = Concentration of carbon dioxide

The required destruction efficiency for PCBs is set forth in the permit for each incinerator unit. Values as high as 99.9999 percent have been issued to date as requirements for PCB-destruction efficiency in approved incinerators.

An extensive amount of monitoring must accompany the operation of the incinerator in order to assure proper operating conditions and to complete PCB destruction. Monitoring requirements include:

- The rate and quantity of PCBs that are fed into the combustion system
- The temperature of the incineration process
- Stack emission products: O_2, CO, CO_2, NO_X, hydrochloric acid (HCl), total chlorinate organic content, PCBs, and total particulate matter.

Incineration of the PCB-contaminated material must be discontinued if, for any reason, the monitoring systems fail. These include the measuring and recording equipment for either the PCB feed rate, operational requirements, or stack emission products. Any violation of the required operating conditions (e.g., minimum excess oxygen levels) would also force a discontinuation of the incineration process.

A key site-specific issue is the regulatory framework related to the presence of heavy metals in the hot-spot sediments. These potentially toxic metals would be charged into the incinerator along with the PCBs, but the process would not destroy the metals, since they are already in their elemental chemical form. At the present time, there are no Federal regulations governing the discharge of metals to the air from an incinerator. The Commonwealth of Massachusetts likewise does not have approved regulations for contaminants emissions, although they are under development. The lack of specific guidelines limits the assurance that any metals released to the air will not pose a significant threat to the local community. Air pollution contol devices that would remove a large percentage of the expected amount of metals are available.

The approval of the incinerator itself falls under the jurisdiction of the EPA Regional Administrator. Before an incinerator can be approved, however, the incinerator must satisfactorily destroy PCBs in at least one trial burn. A waiver could be granted if it is demonstrated that an incinerator that does not satisfy all criteria would not present an unreasonable risk to the public health or the environment. This would be unlikely at New Bedford because of the proximity of the incineration site to residential and commercial areas, and the potentially hazardous compounds that could form as the result of an incomplete incineration of PCBs.

3.4 Public Health and Environmental Effects

Since use of an onsite incinerator would be unavoidably close to residential and commercial areas, public perception of the incineration alternative is of concern. The proximity of residential areas to the site presents a clear source of public awareness and opposition to the incineration of PCB-contaminated materials within the area.

A 1982 air monitoring program conducted by GCA Corporation confirmed the presence of elevated levels of PCBs in the atmosphere near the hot-spot areas. These levels did not exceed the Canadian 24-hour average permissible exposure limit (the only standard available for comparison), but were elevated by about 10 times above typical levels for an urban environment. The addition of potential PCB sources (the incinerator and sediment storage area) would be an added risk to a community that is currently being exposed to low levels of airborne PCBs. These facilities would be active within the harbor area for at least 6 years, a greater length of time than any of the other alternatives. Another risk would be the possible formation and undetected emission of by-products such as polychlorinated dibenzofurans or dioxins as a result of the incomplete combustion of PCBs.

The heavy metals present in the sediments pose an additional risk to the public and the environment. As previously noted, these metals are in their elemental chemical form and will not be destroyed in the incineration process. In fact, the toxicity of some metals may actually increase in some instances as a result of chemical transformation resulting from exposure to the conditions necessary for PCB destruction. For example, chromium presently in a reduced state in the sediments could be oxidized to the highly toxic hexavalent form. A release of these contaminants to the atmosphere and their presence in the incineration residue pose an additional risk to the surrounding community.

3.5 Additional Evaluation Factors

The expected present of toxic heavy metals in the residue of the incineration process is an important consideration in evaluating the cost-effectiveness of this alternative. The current levels of metals such as lead, cadmium, chromium, and mercury are such that the sediments in some areas may be classified as a hazardous waste regardless of the presence of PCBs. In addition, the concentrations of the metals within the sediment matrix would be increased as water is evaporated from the sediments during incineration. The result is that the residue and ashes produced in the incineration process would remain a hazardous waste that would require further treatment or disposal in a secure chemical landfill. In effect, even though the PCBs would be destroyed by incineration, many of the costs and negative effects associated with the nonincineration alternatives would remain because of the presence of the metals.

The time required for completion of a remedial action involving incineration is also a key detriment to the cost-effectiveness of the incineration option. It has been estimated that approximately 6 years would be required to incinerate 1,000,000 cubic yards of contaminated sediment estimated to be in the hot-spot areas. This is based on uninterrupted operation throughout the 6-year period and could be significantly increased if it becomes difficult to maintain the stringent operating conditions due to the high loading rate and variable nature of the sediments. The 6-year period also does not include the time required for the construction, permitting (including trial burns), and approval of the incinerator. At least a 10-year remedial action program is likely, including considerable upfront time (at least 3 years) before any dredging and incineration can begin. The total treatment time can be somewhat reduced by incorporating more or larger rotary kiln incinerators. However, this would greatly increase the capital costs of this alternative and would require additional developmental and construction time.

Estimated costs for the incineration of the total volume of contaminated sediments within the upper harbor are in excess of $70 million. This does not include the costs of support functions such as dredging, dewatering, and water treatment, which would push the cost of remedial action over he $100 million level. This alternative, including support functions, is the most costly alternative when compared to other proposed in the Feasibility Study. As with the time required, these cost estimates are based on favorable operating conditions throughout the period of performance and could be significantly higher if operational difficulties develop.

A scaled-down version proposing only to incinerate those sediments exhibiting PCB levels in excess of 500 ppm would reduce costs somewhat, although the effectiveness of this alternative would suffer. The cost of the incineration phase would be about $50 million; total costs of the remedial action alternative are estimated at nearly $80 million.

The incineration process is a highly inefficient thermal process. Although PCB destruction can be achieved under proper operating conditions, a large percentage of the energy input to the system is wasted. Sediments, even after dewatering, would contain approximately 30 percent water. Not only the sediments but also the water would have to be raised to over 2000°F, thereby requiring large amounts of fuel. Because of the lack of combustible organics in the sediments, essentially all of the large fuel requirements would have to be externally supplied.

3.6 Conclusions and Recommendations

To date, most of the arguments against incineration as a remedial action alternative for the hot-spot areas have focused on the associated high costs and the time for implementation. The estimated cost of the incineration option was found to be approximately four times larger than the costs of other alternatives proposed in the Feasibility Study. These costs were based on optimistic assumptions regarding system performance and would be more susceptible to significant increases than the other, more passive remedial actions. In addition, if a second treatment process is required because of the presence of heavy metals, the costs would increase considerably. The length of time required to achieve complete hot-spot remediation under the incineration alternative was estimated to be several times greater than that required for other proposed alternatives. The incineration alternative also requires the maximum lead time that would prohibit any action within the hot-spot area itself for at least 3 years.

Although the extremely high costs and implementation times in themselves represent considerable justification for eliminating incineration as a cost-effective alternative, other possibly more critical factors can also be identified, and may include the following:

- The incineration of contaminated sediments is not a permanent solution to the overall contamination problem in the estuary, but rather an intermediate step to further treatment or landfilling. The reason is that heavy metals would remain in the residue and ash and would continue to pose a threat to public health and the environment as hazardous chemicals.

- The incineration process may transform the metals to more toxic forms.

- The potential release of PCBs, metals, and possibly toxic by-products to the atmosphere in residential and other developed areas would increase as a result of the stack emissions from the incinerator.

In summary, it is judged that, because of the particular conditions associated with the present contamination in the Acushnet River Estuary, incineration is not significantly more effective than the other proposed alternatives in minimizing and mitigating the damage to public health, welfare, and the environment. The additional costs, the increased time for project completion, and other adverse impacts are not justified by the overall long-term benefits of incinerating the PCBs. The elimination of incineration as a cost-effective alternative remains, therefore, a justified conclusion.

4.0 DISPOSAL AT AN EXISTING, OUT-OF-STATE LANDFILL

4.1 Landfill Disposal of PCB-Contaminated Wastes

For dredge materials containing PCBs in excess of 50 ppm, the current regulatory framework requires that any offsite disposal must take place at an approved facility. One alternative proposed for the remediation of the hot-spot areas in the Acushnet River Estuary involves the construction of an upland chemical waste landfill that would be designed in compliance with RCRA requirements in the immediate vicinity of New Bedford. It is recognized, however, that the regional hydrologic and geologic conditions within a reasonable hauling distance from New Bedford are not consistent with the technical requirements of RCRA. Examples of such inconsistencies are as follows:

- The landfill site should be located in thick, relatively impermeable formations such as large-area clay formations. When this is not possible, the soil should have a high clay and silt content with an in-place thickness of at least 4 feet or a compacted liner at least 3 feet thick. No large-area clay formations are found in the New Bedford area; the soil is primarily of glacial origin with little clay content; and there is a general lack of natural materials in the regional area that would be appropriate for liner construction. A synthetic membrane liner would therefore be necessary.

- The landfill should be located to ensure that the bottom of the liner system is at least 50 feet from the historical high groundwater table. This condition cannot be satisfied in the New Bedford regional area because of the lack of topographic relief and the existence of a high groundwater table in the unconsolidated material overlying the bedrock.

- No hydraulic connection should exist between the site and surface waters, and groundwater recharge areas should be avoided. The coastal location of New Bedford and surroundng communities creates direct links between groundwater and surface water systems. In addition, large areas near New Bedford are underlain by productive aquifers that are currently used for municipal and private water supplies.

In addition to these identified technical limitations, there remains a serious concern regarding the overall acceptability and approval of a chemical landfill in Massachusetts. For these reasons, it was determined that additional considerations should be given to the alternative of transporting the contaminated sediments to an existing, RCRA-permitted landfill outside of Massachusetts. The latter option had been previously evaluated and eliminated as a potential remedial action alternative for the hot-spot areas (see draft report). In this section, a more thorough treatment of disposal at an out-of-state landfill is presented.

4.2 CECOS International Landfill

As of June 1983, nine commercial landfills had been approved by the EPA for the disposal of PCBs. Of these, however, none are located within close proximity to New Bedford. The closest facility is sited in Niagara Falls, New York, and is operated by CECOS International (CECOS). This facility, because of its location, was selected as the potential disposal site for the PCB-contaminated sediments from the Acushnet River Estuary.

CECOS is approved for the acceptance of contaminated dredge spoil of any concentration. It does not, however, accept liquid PCBs. CECOS requires that, upon arrival at its location, there is no free liquid in the dredge spoils. This indicates that a suitable method of sediment dewatering must be implemented prior to transporting the sediments to CECOS. In addition, because of the vibrations that occur during transport, some water may tend to "fall out" of the sediments. Should this occur, it would be necessary to decant the free liquid upon arrival at CECOS. This liquid would then have to be treated or disposed of at an alternate site.

CECOS also required that the dredge material have a load-bearing capacity of 150 pounds per square foor (psf) to withstand the operation of facility equipment. This would require a solids content of approximately 40 percent (by weight), with a consistency similar to that of a filter press cake. If, upon arrival at CECOS, it is determined that the sediments are not of the proper consistency, soils or stabilizing materials may be added until the 150 psf requirement is satisfied. This would increase both the cost of the operation and the volume of material to be disposed.

4.3 Description of Alternative

The individual steps required to implement this alternative are similar to those of the dredging and upland disposal option up through the temporary containment of contaminated sediments within the western cove. These steps are described in the draft report. From the temporary containment site, the material will be pumped to a series of belt filter presses to undergo secondary dewatering. This is expected to result in a filter cake containing approximately 60 percent solids (by weight) to be disposed of by CECOS. The total quantity of material to be shipped is expected to be approximately 600,000 tons, or 450,000 cubic yards. The respective values would be approximately 360,000 tons, or 270,000 cubic yards, if only those sediments with PCB levels exceeding 500 ppm were segregated for disposal at CECOS.

Material exiting the filter presses will be conveyed to a lined stockpile area from which it will be loaded onto trucks and transported to a railyard. The material will be conveyed from the trucks to railroad cars for final transport to CECOS. Barging of the dewatered sediments to the railyard, which is located approximately 1 mile south of the cove area on the west bank of the Acushnet River, was initially considered. It was ruled out, however, because there is not enough clearance under the Coggeshall Street Bridge to enable a tug to proceed upstream. Consideration was also given to the use of trucks for direct haulage to CECOS, but it was found that the cost to transport contaminated sediments to CECOS by truck would be almost double that by rail. The large volume of material to be handled would also pose traffic problems if truck hauling was utilized.

Once transported to CECOS by rail, the sediments would be unloaded at a railroad siding (possibly to be constructed for this purpose), with subsequent disposal in accordance with all agency and site requirements.

4.4 Public Health and Environmental Effects

Since contaminated sediments will be totally removed from the local environment under this alternative, the long-term risks to public health and the environment within the New Bedford area will be minimized. Several adverse effects on public health and the environment are possible in the short term, however. Over a period of at least 4 years, residents of the nearby community will be exposed to a high level of activity in and around the harbor area. Because of the operation of heavy construction and processing equipment, the noise level will be higher than background levels. The flow of traffic into and out of the area over that period of time will also be increased, especially as a result of the hauling of dewatered sediments by truck to the railroad yard south of the Coggeshall Street Bridge.

This alternative requires five stages of material handling and transfer between the time that contaminated sediments are placed in the temporary storage area and their arrival at the CECOS facility. These include pumping to the secondary dewatering process, placement in a temporary stockpile area, loading into trucks, transfer to the railroad cars, and unloading at CECOS. Such handling and transfer requirements result in additional risk of exposure to the onsite operators and the neighboring communities, and also maximizes the potential for sediment drying and the consequent potential for oxidation of the metals and release of contaminants to the atmosphere.

During the rail transport of sediments to CECOS in New York, a derailment or other accident could result in a spill that contaminates soils, surface waters, and/or groundwater in areas not currently affected by the contaminants in the hot-spot areas. In addition to the harmful environmental effects, the spill could also result in health effects to the public.

4.5 Additional Evaluation Factors

A major consideration associated with the transport of contaminated sediments to the CECOS facility is the large volume of waste to be shipped in relation to the available capacity of the facility. Although exact figures are not available, there are indications that the 500,000 cubic yards of dewatered sediments would stress the remaining permitted storage of the landfill (Communication with CECOS representative, September 9, 1984). If new areas had to be constructed and permitted for PCB disposal, both the costs for this alternative and the time to complete the action would be significantly increased. The use of an alternative site would likewise increase the costs, due to the additional hauling distance.

A more basic question arises as to the feasibility of using 500,000 cubic yards of currently available RCRA storage in order to achieve complete remediation at a single Superfund site. This is analogous to the issue of fund-balancing, since it must be determined whether national public health, welfare, and environmental concerns related to Superfund sites would be better served by utilizing the same capacity for the disposal of wastes from a number of smaller sites. This is a particularly valid question in the case under study since it has been judged that other remedial action alternatives involving contaminant isolation or local disposal would be comparably effective in minimizing and mitigating the damage to public health, welfare, or the environment. At other sites, the local conditions and types of contaminants may be such that disposal at CECOS is the only (or most) cost-effective alternative available.

The time required for completion of a remedial action involving out-of-state disposal will be longer than that required for any of the other dredging and disposal alternatives. The limiting factors have been found to be the time required for secondary dewatering of the sediments and for loading and transporting them off site. Although these processes can begin soon after the commencement of dredging, the entire remedial action will require at least 4-1/2 years to complete. This time estimate assumes that favorable logistics can be established and maintained throughout the processing, transfer, and transport system over the entire period of operation. If, for example, the necessary volume and schedule of rail access cannot be obtained, the completion time could be extended far beyond 5 years.

In addition to the large amount of time required for the out-of-state hauling of sediments, costs will be substantially greater than those of other alternatives being considered for the site remedial action. This cost increase is due to three main factors: (1) the requirement for secondary dewatering of the sediments prior to hauling; (2) the hauling costs for transport by truck/railroad from the project area to the CECOS facility in New York; and (3) the cost charged by CECOS to dispose of the materials. The sum of these additional costs has been estimated to be greater than $75 million ($50 million for sediments with PCB concentrations of greater than 500 ppm), which in itself is approximately three times greater than the total estimated cost for other proposed alternatives. The costs of dredging and temporary storage must also be considered, which pushes the total costs of the out-of-state disposal option to above $100 million. The total estimated cost of the alternative in which only sediments with PCB levels exceeding 500 ppm are shipped to CECOS exceeds $100 million since a permanent disposal area must also be constructed for those sediments with lower PCB concentrations.

The cost of this out-of-state disposal may increase further, depending on the characteristics of the sediments. For example, the requirement that there be no free-standing liquid upon arrival at CECOS necessitates the addition of secondary dewatering, as previously stated. If more liquid "falls out" during transport, it will need to be decanted off and treated prior to disposal. This will result in increased costs for this alternative, which are estimated at $100 to $150 per ton. Should the dredge spoils not meet the 150 psf requirement for load-bearing capacity, stabilizing materials will need to be added at an additional cost of $20 to $40 per ton of material. Any such cost increase will cause this alternative to become even less cost-effective.

4.6 Conclusions and Recommendations

Section 101 (24) of the Comprehensive Environmental Response, Compensation, and Liability Act (i.e., the Superfund Act) requires that any remedial measure which includes offsite storage, treatment, destruction, or secure disposition of hazardous substances must: (1) be more cost-effective than other remedial measures; (2) create new disposal capacity in compliance with Subtitle C of RCRA; or (3) be necessary to protect public health, welfare, or the environment from a present or potential risk that may be created by further exposure to the hazardous substances. It is concluded that the alternative of dredging the contaminated sediments from the Acushnet River Estuary with disposal in an out-of-state landfill does not effectively satisfy any of these requirements of the Superfund Act. As such, it is recommended that this alternative be eliminated from further consideration.

In relation to the other alternatives being proposed for remediation of the hot-spot areas, the out-of-state disposal alternative has substantially higher costs (approximately a fourfold increase relative to the least costly alternative) and requires considerably more time to achieve the desired level of cleanup. While is it recognized that the ultimate result does totally eliminate the long-term risk to the local communities and environment, it is also judged that the nature of the study area and contaminants are such that any of the alternatives provide a comparable level of cleanup with only a small associated long-term risk. This latter conclusion is discussed in more detail in the draft report. Further, under the out-of-state disposal option, potential long-term problems are being introduced to areas which are not currently affected by the contaminated sediments in the hot-spot areas.

The second criterion of creating new disposal capacity is obviously not being satisfied under this alternative. In fact, storage capacity that would likely be a critical part of the most cost-effective alternative at a number of other sites would be lost if the contaminated sediments from the Acushnet River Estuary are disposed at the CECOS facility.

The question of whether disposal at CECOS is a necessary action to protect public health, welfare, and the environment has already been discussed. In short, each of the five remedial action alternatives presented in detail in the draft report and in another section of this addendum would provide adequate protection at less cost and in a shorter period of time.